THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LIX. No. 1497.] LONDON, JANUARY 19, 1892. [44TH YEAR. PRICE 6d.

WOLSTON'S Paste and Ready Mixed for Use.
Guaranteed Free from Adulteration. **TORBAY PAINTS.**
FOR GASHOLDERS, &c., &c.
The Original "Torbay Paints" As supplied during the present and many preceding years to the LONDON GASLIGHT & COKE COMPANY.
Special Quotations to Gas Companies.
TORBAY & DART PAINT Co., Ld.,
DARTMOUTH, DEVON,
And 23, St. George St., Westminster, S.W.

— ESTABLISHED 1830. —
PARKER & LESTER,
Manufacturers & Contractors.
THE ONLY MAKERS OF
PATENT ANTIMONY PAINT,
Parker's Imperial Black Varnish,
Oxide Paints, Oils, and General Stores for Gas and Water Works.
WORKS:
ORMSIDE STREET, OLD KENT ROAD, LONDON.
Ashmore, Benson, Pease, & Co., Ld.,
STOCKTON-ON-TEES,
Manufacturing Gas Engineers.
See Advertisement, p. 97.

CEMENT
EARLE'S
BEST
Portland Cement
MANUFACTURED BY
GEO. & THOS. EARLE,
HULL.
Offices: 7, 8, & 9, PIER STREET.
Works: WILMINGTON.
STOREAGE CAPACITY 10,000 Tons.
ESTABLISHED 1811—OVER THREE QUARTERS OF A CENTURY
Telegraphic Address: "CEMENT HULL."

NORTON'S PATENT
"ABYSSINIAN" & ARTESIAN TUBE WELLS,
FOR TOWN WATER-WORKS AND OTHER SUPPLIES.
The following Town Water-Works Supplies have been obtained by this System, viz.:—Abbott's Langley, Aldershot, Alnwick, Cirencester, Hertford, Lechlade, St. Albans, Shrewsbury, Skegness, Southampton, Stony Stratford, Swansea, Wallingford, Watford, West Worthing, Wimborne, &c.
LE GRAND & SUTCLIFF,
HYDRAULIC ENGINEERS, 100, BUNHILL ROW, LONDON, E.C.

SELF-CONTAINED DUST-FUEL FURNACE.
MELDRUM'S PATENT.

Extract from the *Smethwick Telephone,* June 13, 1891.

GAS COMMITTEE.

"The Manager [B. W. Smith, Esq.] reported that the adoption of MELDRUM'S PATENT FURNACES, he estimated, had resulted in a saving of 150 tons of Slack during the nine months they had been at work in the Boiler-House, and 360 tons of Slack during four months in the Retort-House; the fuel used in place of slack being the fine coke dust which formerly had to be carted or boated away at considerable expense."

MELDRUM BROS., Engineers,
ATLANTIC WORKS, 13, CITY ROAD, MANCHESTER.

DANIEL HOWARD,

(Successor to the late BENJ. WHITEHOUSE),

GASHOLDER & BOILER WORKS,

WEST BROMWICH, NEAR BIRMINGHAM

(ESTABLISHED 1765).

MANUFACTURER OF TELESCOPIC AND SINGLE GASHOLDERS,

WROUGHT AND CAST IRON TANKS FOR DITTO,

PURIFIERS, CONDENSERS, SCRUBBERS, HYDRAULIC MAINS, and all kinds of GAS APPARATUS,

Wrought-Iron Roofs, Bridges, Girders, &c.,

Steam, Hot Water, and Range Boilers, Tanks, Cisterns, Boats, and all kinds of Wrought-Iron Work.

DRAWINGS, SPECIFICATIONS, AND ESTIMATES SUPPLIED ON APPLICATION.

EDWARD COCKEY & SONS, LIMITED,

ENGINEERS & CONTRACTORS FOR GAS-WORKS.

TELEGRAPHIC ADDRESS: "COCKEYS FROME."

PRICES ON APPLICATION TO THE SOLE MAKERS.

THE IRON-WORKS,
FROME.

Messrs. COCKEY desire to draw the attention of Gas Engineers and Managers to their new form of GAS WASHER, which, by a recent patent, converts their HORIZONTAL Washer into one of a VERTICAL form.

The principle is the same as in the horizontal one, which has now been before the profession for a number of years, and where adopted is giving unqualified satisfaction.

The Washer is entirely automatic in its action, and does not therefore need any motive power—an advantage which will be apparent to all.

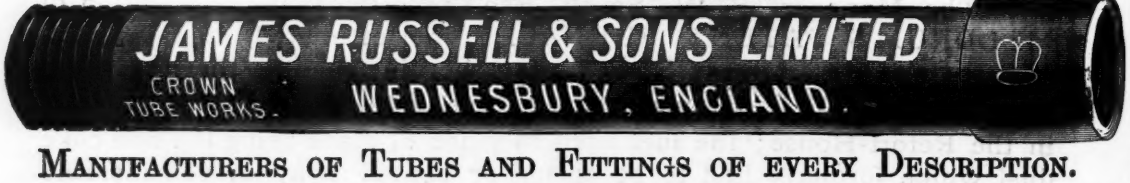
It is made in all sizes, from 25,000 TO 3,000,000 FEET PER DAY; and Messrs. COCKEY invite inquiries, which shall have early attention.

March, 1891.

THE IRON-WORKS, FROME SELWOOD, SOMERSET.

HIGHEST AWARDS—LONDON, PARIS, COLOGNE, VIENNA, MELBOURNE, AND OTHERS.

—11 MEDALS.—



MANUFACTURERS OF TUBES AND FITTINGS OF EVERY DESCRIPTION.

WROUGHT-IRON OR STEEL MAINS UP TO 6 FEET DIAMETER, FOR GAS, WATER, OIL, OR OTHER PURPOSES.

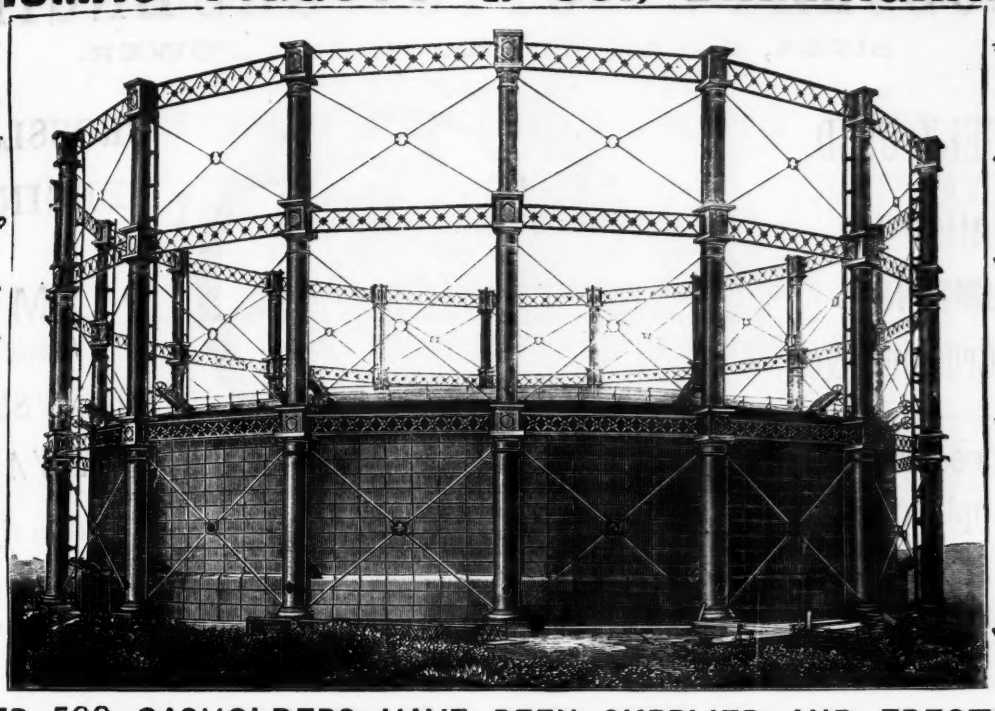
SCREWING TACKLE, BOILER MOUNTINGS, VALVES, COCKS, ETC.

LONDON: 108, Southwark Street. BIRMINGHAM: 114, Colmore Row. LEEDS: 6, Mark Lane, New Briggate.

THOMAS PIGGOTT & CO., BIRMINGHAM.

LONDON OFFICE: ST. THOMAS APOSTLE, E.C.

GAS PLANTS, BOILERS, ENGINES, PUMPS, ROOFS, RETORT. FITTINGS, ETC.



TELEGRAPHIC ADDRESS: ATLAS, BIRMINGHAM.

WELDED & RIVETED PIPES, FOUL MAINS, RETORT-LIDS, WROT & CAST TANKS, PURIFIERS.

OVER 500 GASHOLDERS HAVE BEEN SUPPLIED AND ERECTED,

INCLUDING THOSE SUPPLIED TO THE FOLLOWING GAS COMPANIES AND CORPORATIONS:

BATH.	BOLTON.	BRISTOL.	CHELTENHAM.	LEAMINGTON.	PRESTON.	SHEFFIELD.
BELFAST.	BOMBAY.	BRISBANE.	HARTLEPOOL.	LIVERPOOL.	READING.	STOCKHOLM.
BECKTON.	BRADFORD.	CARDIFF.	LEEDS.	NOTTINGHAM.	RIO GRANDE.	SYDNEY.
BIRMINGHAM.	BRIGHTON.	COVENTRY.	LEICESTER.	OLDHAM.	SOUTH METRON.	VIENNA.

GAS COAL.

BEST

REAL OLD SILKSTONE GAS COAL,

Address, THE STRAFFORD COLLIERIES COMPANY,

Near BARNSLEY, SOUTH YORKSHIRE.

NEWTON, CHAMBERS, & CO., LIMITED

THORNCLIFFE IRON-WORKS, near SHEFFIELD,

MANUFACTURERS OF

SLIDE VALVES, WITH RACK & PINION, OR Internal or External SCREWS, of all Sizes.

GASHOLDERS, AND Gasholder Tanks.

CAST-IRON RETORTS,

RETORT-BED FITTINGS,

And Retort-House Appliances

of every description.

Iron Roofs, Columns, Girders, Floor Plates and Tools, &c.

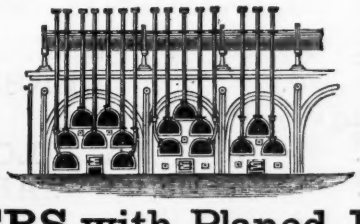
WROUGHT AND CAST IRON CONDENSERS, SCRUBBERS, & WASHERS,

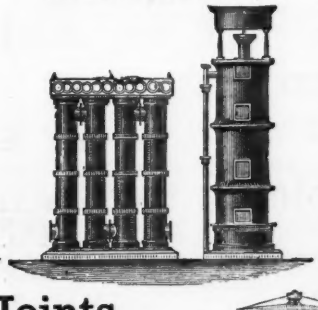
TAR AND LIQUOR PUMPS, &c.

PATENT CENTRE VALVES

for working Purifiers.

Also Bye-Pass & Stop Valves.





PURIFIERS with Planed Joints,

HAND and HYDRAULIC LIFTING GEAR, CAST-IRON MAINS and SPECIALS,

WOOD GRIDS.

CAST AND WROUGHT IRON TANKS AND CISTERNS.

DESIGNS, SPECIFICATIONS, AND ESTIMATES FREE.

Pig Iron (*Special Quality*) for ENGINE CYLINDERS, &c.

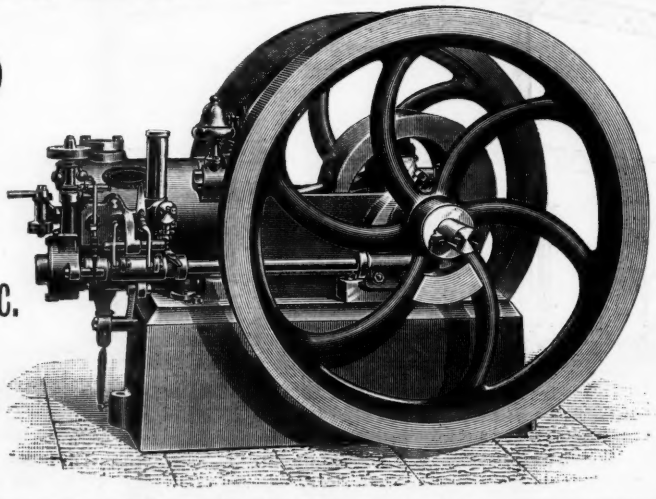
GAS COAL FAMOUS FOR ITS UNRIVALLED EXCELLENCE.

CROSSLEY'S "OTTO" GAS-ENGINE.

SIZES, 2-MAN TO 200-HORSE POWER.

LARGELY USED FOR **EXHAUSTING, PUMPING,** Coke Crushing, &c.

Reduced Prices on Application.



CROSSLEY'S ENGINES, Combined with **PUMPS** FOR *TOWNS' SUPPLY, SEWAGE, &c., &c.*

CROSSLEY'S NEW HIGH-SPEED ENGINE FOR DIRECT ELECTRIC LIGHTING.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

HARRIS & PEARSON,
STOURBRIDGE, ENGLAND.
MANUFACTURERS OF
FIRE-CLAY GAS-RETORTS, FIRE-BRICKS, LUMPS, & TILES of Every Description.
GLAZED BRICKS AND PORCELAIN BATHS.

AVOID ACCIDENTS TO GASHOLDERS THROUGH FROST

BY ADOPTING

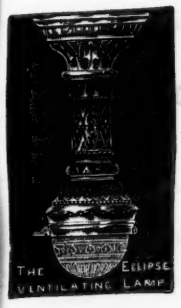
CUTLER'S PATENT FREEZING PREVENTER.

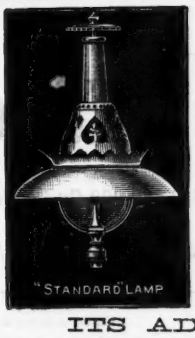
ADOPTED AT THE FOLLOWING WORKS:—

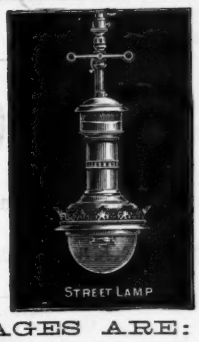
LONDON. GASLIGHT and COKE COMPANY, BETHNAL GREEN.
Do. Do. Do. KENSAL GREEN.
IMPERIAL CONTINENTAL WORKS, HANOVER.
Do. Do. Do. VIENNA. FLORIDSDORF.
Do. Do. Do. Do. TABOR.
COPENHAGEN. GREAT YARMOUTH. HERTFORD.
KING'S LYNN. BROMLEY (Kent). WARWICK.
KINGSTON-upon-HULL. RICHMOND (Surrey).

16, GT. GEORGE ST., WESTMINSTER, S.W. **S. CUTLER & SONS,** PROVIDENCE WORKS, MILLWALL, LONDON.

"LIGHT, Wenham Gas Lamps MORE LIGHT."







ITS ADVANTAGES ARE:

IMMENSE ECONOMY IN THE CONSUMPTION OF GAS.

INTENSITY, PURITY, AND STEADINESS OF THE LIGHT.

Absence of Downward Shadow. Practical Completeness of Combustion.

CAN BE FITTED TO ORDINARY SUPPLY-PIPES WITHOUT ALTERATION.

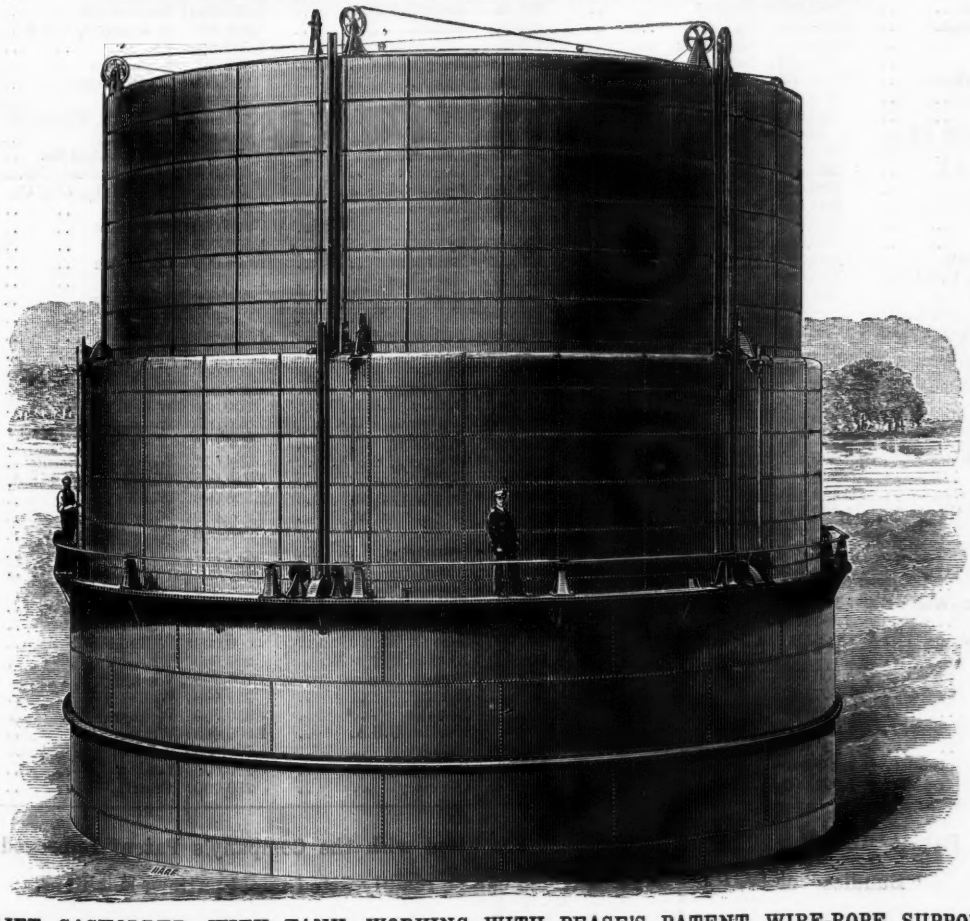
CAN BE USED AS VENTILATING LIGHTS, whereby the products are removed, and damage to decorations, &c., prevented.

SOLE PROPRIETORS AND MANUFACTURERS: **THE WENHAM COMPANY, LIMITED,**

Birmingham Branch: 4, DALE END. Works: UPPER OGLE ST., LONDON, W. Manchester Branch: 5, DEANSGATE.

ASHMORE, BENSON, PEASE, & CO., LTD.,

STOCKTON-ON-TEES.



TWO-LIFT GASHOLDER, WITH TANK WORKING WITH PEASE'S PATENT WIRE-ROPE SUPPORTS.

(From Photograph.)

KIRKHAM, HULETT, & CHANDLER, LIMITED,

[SIDNEY HERSEY, Managing Director.] [J. CHANDLER, Engineer.]

436 Patent "Standard" Washer-Scrubbers,

Capable of extracting the whole of the Ammonia from 410,680,000 Cubic Feet of Gas per 24 hours.

Erected and in course of construction at present date, amongst them being the following, viz.:—

	Capacity. Cubic feet per day.
Altrincham	600,000
Adelaide	600,000
Aldershot	200,000
Allegheny, U.S.A.	1,000,000
Ashton-under-Lyne	1,250,000
Amsterdam (2)	1,500,000
Annaberg	200,000
Arcachon	100,000
Animal Charcoal Co.	200,000
Altoona, U.S.A.	350,000
Buxton	250,000
Bradford (3)	1,000,000
„ (3)	1,250,000
„	3,000,000
Bremen	150,000
Baltimore, U.S.A. (3)	1,000,000
Balmain, N.S.W.	125,000
Bishops Stortford	150,000
Blackpool	400,000
Brussels (3)	1,250,000
„	750,000
Banbury	250,000
Birmingham (2)	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
Boston, U.S.A.	2,000,000
Brisbane	1,500,000
„	300,000
Burton-on-Trent	1,500,000
Barcelona	350,000
Barking	100,000
Baerlien & Co. (2)	20,000
Bombay	700,000
Buffalo, U.S.A.	550,000
„	500,000
Brooklim, U.S.A.	300,000
Bergen	250,000
Berlin	150,000
Bournemouth	1,000,000
Bridgeport, U.S.A.	500,000
Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
Brooklyn, U.S.A. (2)	1,000,000
Brunner, Mond, & Co.	400,000
Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A.	500,000
Cincinnati, U.S.A. (2)	1,500,000
Chicago, U.S.A.	3,000,000
„ (2)	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas-Works Co.	100,000
Cadiz	300,000
Charlottenberg	600,000
Dudley	750,000
Driffield	100,000
Dukinfield	500,000
Dover	750,000
„ (2)	1,000,000
Deal	200,000
Derby (2)	1,500,000
„	1,000,000
Dublin	3,000,000
Dowlais	100,000
Douai	500,000
Denton	500,000
Derby, U.S.A.	350,000
Denver, „	500,000
„ „	1,000,000
Düsseldorf	750,000
„	500,000
Dumfries	250,000
Dunedin, N.Z.	400,000
Darlington	1,250,000
Detroit, U.S.A.	750,000
Edinburgh	1,500,000
„	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150,000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshütte	500,000
Fürth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W.	100,000
Grieg	300,000
Georgetown, U.S.A.	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havanna, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
„	750,000
„	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwike	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A.	1,000,000
Ilkeston	300,000
Inverness	250,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Königsberg	1,000,000
King's Lynn	300,000

LONDON:—	Capacity. Cubic feet per day.
The Gaslight and Coke Co.:—	
Beckton (6)	1,250,000
„ (2)	2,500,000
Silvertown	1,000,000
LONDON—Continued.	
The Gaslight and Coke Co.:—	
Bromley (2)	2,000,000
„ (4)	1,500,000
Shoreditch	2,500,000
Pancras (2)	1,500,000
Pimlico	2,000,000
Nine Elms (2)	3,000,000
Kensal Green (2)	3,000,000
South Metropolitan Co.:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall (2)	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
„	3,000,000
Leeds (2)	2,000,000
„ (4)	3,000,000
Leominster	150,000
Leiden	560,000
„	600,000
Liverpool (5)	2,000,000
„ (4)	3,000,000
Lincoln	1,000,000
„	600,000
Lowell, U.S.A.	1,000,000
Laclede, „	1,000,000
Louisville, „	1,500,000
Long Eaton	500,000
Lille	900,000
„	450,000
„	750,000
„ (2)	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U.S.A.	250,000
Lawrence, „	500,000
Lynn, „	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles (2)	1,500,000
Mons	500,000
Malines	250,000
Melbourne (5)	1,500,000
Manchester (2)	2,500,000
„	400,000
Middleton	400,000
Manley, N.S.W.	100,000
Minneapolis, U.S.A.	750,000
Magdeburg	300,000
Memphis, U.S.A.	750,000
Nottingham	1,250,000
„ (2)	2,500,000
„ (2)	2,000,000
„	1,500,000
Newport, U.S.A.	430,000
Newmarket	150,000
Newark, U.S.A.	680,000
Northfleet	200,000
New York, U.S.A.	2,000,000
Nice	600,000
Newcastle, N.S.W.	200,000
Numea, „	100,000
Namur	250,000
Newark	350,000
Nassau, U.S.A.	1,000,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N.S.W.	100,000
Prescot	150,000
Providence, U.S.A. (2)	750,000
Plauen (2)	300,000
Portsmouth (2)	2,500,000
Pittsburg, U.S.A.	1,500,000
Portland, „	560,000
Pawtucket, „	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A.	250,000
Roxbury, „	500,000
Runcorn Soap Co.	20,000
Rockhampton, N.S.W.	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Smethwick	750,000
Sydney, N.S.W. (2)	1,000,000
„	2,500,000
Sunderland	1,500,000
St Joseph's, U.S.A.	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
„	1,500,000
St. Louis, U.S.A. (2)	2,000,000
„	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A. (2)	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A.	750,000
Toronto	1,000,000
Uxbridge	300,000
Valparaiso	500,000
West Bromwich (2)	1,000,000
Willenhall	250 000
Weston-super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A. (2)	600,000
Wellington	150 000
Warwick	300,000
Wheeling, U.S.A.	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A.	500,000
Windsor, N.S.W.	100 000
Wolverton	100,000
Wellington, N.Z.	250,000
Whitchurch	175,000
Washington, U.S.A.	2,000,000
Wallasey	750,000
Weimar	150,000
Wurzen	200,000
Worcester, U.S.A.	750,000
Yeadon	500,000
Yeovil	250,000

All New Patent "Standard" Washer-Scrubbers are fitted with the Company's Patent Improved Wooden "Bundles" or Washing devices, which can be readily fitted to old pattern Machines.

Address: 3 & 4, Palace Chambers, Bridge St., Westminster, London, S.W.

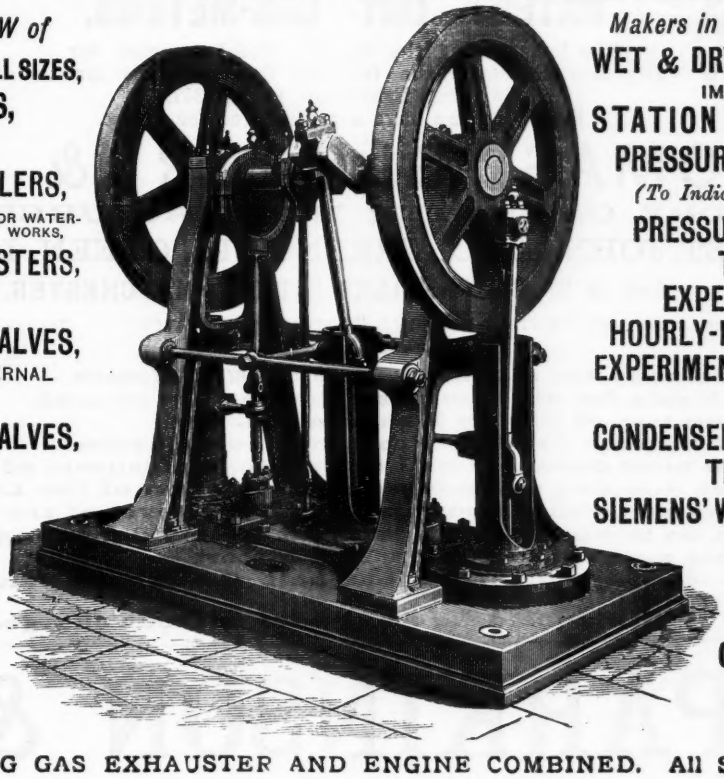
R. LAIDLAW & SON,

GAS AND WATER ENGINEERS.

Manufacturers of **GAS APPARATUS** of every Description.

Makers in GLASGOW of

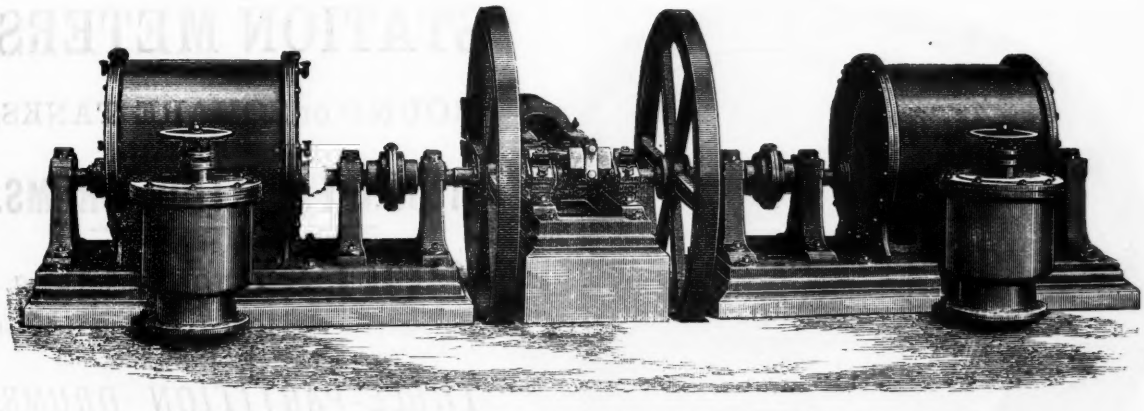
CAST-IRON PIPES, ALL SIZES,
LAMP PILLARS,
STEAM-ENGINES AND BOILERS,
PUMPING ENGINES FOR WATER-WORKS,
BEALE'S GAS EXHAUSTERS,
DOUBLE-FACED SLUICE VALVES,
INTERNAL AND EXTERNAL RACK OR SCREW SLIDE VALVES,
CAST-IRON COLUMNS,
BEAMS, GIRDERS, AND WATER-TANKS,
WROUGHT-IRON TUBES, FITTINGS, &c.



Makers in EDINBURGH of

WET & DRY GAS-METERS,
IMPROVED STATION GOVERNORS,
PRESSURE REGISTERS *(To Indicate Now Time)*,
PRESSURE GAUGES,
TEST HOLDERS,
EXPERIMENTAL HOURLY-RATE METERS,
EXPERIMENTAL TEST METERS,
CONDENSER THERMOMETERS,
SIEMENS' WATER-METERS,
STREET LANTERNS,
And all Kinds of GAS APPARATUS AND FITTINGS, &c.

PUMPING GAS EXHAUSTER AND ENGINE COMBINED. All Sizes.



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[See also Advt., p. 133.

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NOTICE TO SUBSCRIBERS

AS TO PAYMENT OF SUBSCRIPTIONS IN ADVANCE.

Subscribers who desire to avail themselves of the reduction in the Subscription to the JOURNAL (21s.) by paying in advance for the Year 1892, are reminded that this can only be done during the month of January.

THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JANUARY 19, 1892.

First Meeting of the Board of Trade Commission.

THE first meeting of the Board of Trade Commission on Standards of Light was held on Friday last, when Dr. Odling, one of the nominees of the Department, was unanimously elected Chairman. The Commission as finally constituted is rather more numerous than can be called in strictness necessary for the proper performance of the work in hand; but when once the principle of representation had been admitted, it was obviously impossible to draw the line closer. There are enough members on the Commission now to ensure the full presentment of the subject in all its issues before a body strong enough to neutralize any sectional feeling within itself, and authoritative enough to impose its judgment upon the gas industry at large. There was no opening, in the constitution of the Commission, for any representative of either the provincial gas interest or that of electric lighting. We are not sure whether the latter would have *locus standi* before the Commission, notwithstanding the plain fact that candle power means almost as much to electric lighting companies as it does to gas manufacturers. With respect to the non-Metropolitan gas undertakings, however, there can hardly be a doubt that the Commission would deal in good part with any representations that these may desire to make before the close of the present proceedings. The undertakings in question are not immediately concerned with the subject-matter of the labours of the Commission; but if they were to organize themselves with a view to secure attention for any special points upon which they might desire to offer some observations, they would not lose their pains. It is well known that the ways of gas testing in and out of London are different; and it would be as well for the Commission to take account of these differences. Common gas in London, to mention only one matter, means 16-candle gas. The same term has different meanings in various parts of the kingdom—the distinguishing adjective being indeed usually dropped, and "gas" meaning just what the local taste, regulated to some extent by local law, prefers to have it. Strictly speaking, all this has nothing to do with the Commission; but it would nevertheless be as well for their report to rest upon as wide a basis as can be obtained for it. In the meanwhile, nothing but good can come of the free discussion of the subject in the "Correspondence" columns of the JOURNAL. Here is no limitation, on the score of place of origin or any other, to shut out pertinent suggestions or sound criticism. We accordingly welcome Mr. H. Leicester Greville's letter, which appears to-day, and offer the additional suggestion that intending correspondents should pay particular attention to the principal points of his five recommendations. These are all important, and ought to be well threshed out before the Commission.

The Punishment of a Demagogue.

ON Friday last, Mr. Justice Denman and a special jury determined the action of *Higgins v. Ward*, to which reference has once or twice been made in these columns. This was the suit for damages for slander, brought by a stoker in the employ of the South Metropolitan Gas Company against the Assistant-Secretary of the Gas-Workers' Union, which has been the subject of wilful misrepresentation by the organs of Trade Unionism, wherein it has been described as brought by Mr. Livesey against a praiseworthy official of the Union—of course, for personal reasons. The misrepresentation went forward as briskly as this kind of business usually does; being, it may be supposed, carefully attended to by the Father of Lies. At any rate, it found its way into the *Echo*, and furnished the Editor of that respectable print, which has devoted some attention to gas matters of late, with occasion for an expression of wonder that Mr. Livesey should have deemed it worth his while to set the law in motion against a Trade Union official. This stupid story has now been exposed; and we may, it is to be hoped, consider that we have heard the last of it. The substratum of facts, without which no misrepresentation could endure for an instant, was supplied in this instance by the circumstance that the Directors of the South Metropolitan Gas Company, with Mr. Livesey, as Chairman, at their head, allowed it to be known to all and sundry whom it might concern, that they are prepared, at all times and by all proper methods, to afford the fullest protection to their servants when molested in the discharge of their duty. The energetic Ward, in the course of his operations against the Company and their loyal workmen—between whom and his party there is, and must be, war to the death—forgot the truth that the arm of the law is long enough and strong enough to reach an orator even through a mass meeting. The policeman on the edge of such a gathering is there to keep the peace. But brickbats are not the only means of offence against which the law has a remedy; and Ward has lived to learn, in the fashion reported in another column, that even a non-unionist stoker has rights which it behoves a stump-orator to respect. In truth, enthusiastic Trade Unionists, Socialists, and Anarchists—for the parts appear to be interchangeable—have had several "heavy

"blows and great discouragements" of late. This order of gentry have a vague notion that "old Father Antic, the Law," ought to stand aside and let them exercise what they are fond of calling a "free hand." It is very noticeable how catch-words of this sort continually pass current in the newspapers and among the mass-meeting spouters of this particular stamp. The newspaper scribes, safe in their anonymity, fulminate in grandiose language about the "sacred right of insurrection," and are always prating of the urgent necessity of "mending or ending" something. These scraps of incendiary journalism are caught up by the professional agitators, and by them and their following translated into all sorts of fantastic actions. The net result of all the writing, and speaking, and processionizing is, that some feather-brained folks fall into the mistake of imagining that they can do as they please, even to the extent of directing Parliament to pass such laws as they deem to be desirable, while they reserve full licence to set at naught any law of which they disapprove. Alas for the fancy! The fervid denunciations, the frantic vilifications that go down so well with the unwashed multitude, which affects to believe that the question of liberty of speech is bound up with the tolerance of obstruction of some particular thoroughfare, and likes its Trade Unionism served up hot with personalities, do not avail to turn aside the cold rigour with which the law visits slander and incitement to violence. It is all very well for a Ward to point with personalities his interested onslaughts upon stokers who refuse to support the Union which made such miserable failures in Salford and South London—he does so at his peril. It is very bold for a Clem Edwards to attempt to terrorize over a firm that defies him and his colleagues—he has to look to himself when the latter "stand from under." It is unnecessary to multiply instances. If the Trade Unionists and the Social Democrats who lead and live upon them could make their own Parliament, appoint their own Judges and Magistrates, pack the juries, and govern the police, then, as they put it, they would receive justice—which is as much as to say that then only would they get their own way in everything. Meanwhile, they must abide by the law as it stands, like other people.

An Experience Confirmed.

THE reflection that "the wise old world is mostly right," is one that those who endeavour to strike out, and live by, strange rules of their own devising, sooner or later have borne in upon them by force of circumstances. Purveyors of commodities under any system of constant delivery, such as gas distributed through pipes leading into the consumers' premises, have repeatedly tried to do without meters, and to determine their charges by apparently simpler and cheaper means. But all such devices fail in turn; and the meter asserts its superiority to any "rental" system, however artfully devised. It has been so with the supply of electricity for lighting; and also with the natural-gas Companies of certain of the United States. The experience of the latter is particularly instructive. The system of charging at first adopted by the latter Companies was after a fixed monthly rate per cooking-stove, fire-grate, or other apparatus connected to the service, without any reference to size or to the quantity of gas required. This plan did not give satisfaction to anybody. People who had small stoves or fire-places objected to pay as much as others with larger grates; and paying for the service, whether the gas was used or not, was regarded as a grievance. On the other hand, the system led to very great waste. There was no inducement to economize; and it was less trouble to keep the gas burning day and night than to turn it off and light it whenever wanted. An attempt was next made to meet some of the objections by rating the stoves and grates proportionately to the size of the house. But the trouble was not removed thereby, for allegations of unfair reckoning became rife; and when gas ran short, the consumers complained that the Companies made no corresponding deduction from their charges. Yet another system tried was the supply by means of "mixers" of different sizes, which it was supposed would deliver gas in quantities proportionate to their capacity. But here again there was no inducement to economize, except in the size of the mixer; and the result was that apparatus very wasteful of gas, and yet too small to be of any real use for its intended purpose, caught the consumer's fancy. At last a suitable meter made its appearance; and although at first the consumers looked upon these appliances for teaching economy in the use of gas as devices of the Companies for increasing their revenues, their use has spread, until at the present time most of the natural gas supplied to houses in the neighbourhood of Pittsburgh is paid for by meter. So experiences repeat themselves.

The Home Coal Trade of 1891.

AN interesting article upon the "Home Coal Industry in "1891" has appeared in *The Times*. It commences with the statement that, "after enjoying for about two years "a period of unusual prosperity, the coal trade of the "United Kingdom has suffered a relapse to its former "and more normal condition of keen competition and low "prices." This observation, being supported by sufficient evidence, will sound like good tidings in the ears of gas managers, who probably consider that they have suffered a great deal more than they deserved at the hands of the coal people during the "period of unusual pros-"perity" in question. The writer in *The Times* explains the relapse in the coal trade by referring to the contraction of demand in the iron and steel, engineering, and other industries; and also to the fact that the resources of production have been greatly increased within the last two or three years. Between 1886 and 1890 there was an increase of more than 17 million tons in the home consumption of coal, which was far too great an expansion of trade to continue. The demands for coal for household use, for railway consumption, and for gas making are all expected to show an increase for 1891; but for other purposes there was an "unmistakeable and pretty general" falling off in the latter part of the year. This is a striking corroboration of the views expressed upon the same subject in our "Retrospect" of the year just ended. The extent of the revival of the coal trade referred to in the article now under notice is marked by the increased value of the coal exports, which rose from 8·32s. per ton in 1887, which was the lowest recorded for a very long time, to 10·21s. in 1889, 12·62s. in 1890, and 12·2s. in 1891. The result of this rise in values has been that "the coal industry has "had between 30 and 40 millions sterling more to dis-"tribute during each of the last two years, in the form of "either profits or wages, than it had in 1887." It is computed that at least one-half of this additional money went in the shape of advanced wages; but this does not imply that all the rest was increased profit for the owners, because, among other heightened sources of expense which they had to bear at the time, the shorter hours worked by the miners figured for something considerable. All these things are now settling down to something like the old level; so that, if they only display the most ordinary capacity for business, gas manufacturers may reasonably expect to be able to buy their coals at low rates once more. Of course, those who buy in a panic, and arrange their contracts in a way that invites hostile combination among the coal-owners, will have to pay the usual premium on mismanagement. Some buyers seem to regard it as the height of prudence to give 1s. a ton more for their coa than anybody else. But the last year or two has hit several of these oddly-constituted gentry pretty hard; and they may do better for the future. It may seem like brutality to the coal-owners that gas-coal buyers should openly rejoice at the collapse of the market, which cuts off all, or nearly all the profit margin from their new contracts; and we can well understand representatives of the coal interest asking, "more in sorrow than in anger," how gas manufacturers would like to work for nothing. Well, the position needs some explanation, perhaps; and it does seem hard if, as is said, the coal-owners' share of profit upon the output of his pits is only about 9d. per ton, that he should not be able to depend upon realizing this modest proportion of the gross value of the commodity. As a question of principle, it is hardly to be imagined that gas manufacturers or any other buyers of coal entertain the slightest objection to the owner getting his normal 9d. per ton profit; but the worst of it is that there is "neither "rhyme nor reason" in the various fluctuations of the coal market. Why, for example, should gas makers, whose requirements are perfectly regular and their money good, be asked to pay 50 per cent. more for the same coal in 1890 than they could get it for in 1887? "Please, Sir, it "isn't me!" cries the innocent owner. So says the miner; and so says everybody concerned. All the buyer knows is that he has to pay "through the nose" for the coal he requires; and be thankful for what he gets. It

is the "state of the market" which is responsible for the consumers' sufferings; and it is hardly to be wondered at that, when he understands that this formless but very real oppressor of his has collapsed, he should rejoice with exceeding joy, and refuse to pity the long-faced sellers, groan they never so touchingly.

Some American Topics.

It is understood that the great American press and the greater American people suit one another in at least one regard—that the former is never weary of publishing, nor the latter of reading, any sort of printed matter that can be described as being "mainly about people." It does not greatly signify who the people are, nor what is said about them. The point is that personal chatter *per se* ranks above everything else, and that no sense of intrinsic values with regard to matter, nor of grace of style, nor of clearness of expression, interferes with the pre-eminence of the "personal paragraph" in American journalism. If this is the correct view, the "gas men" of the United States ought to be happy just now, for they have several first-class eruptions of personalities in full blast. To begin with, there is the squabble in the membership of the American Gaslight Association regarding the knotty point whether President Harbison was or was not justified in saying unkind things of a journalistic critic who is apparently not without backers in the Association. Then there is a good bit of shuffling going on in respect of the management of one of the New York gas undertakings; and prominent names are being shifted about from one place to another, after a fashion that gives colour to the suspicion that, even across the Atlantic, gas management is still far from being "all "beer and skittles." The efforts of the native gas industry to secure "bold advertisement" at what, in the perverse Yankee tongue, is called the Chicago "Exposition," and the discouragement which these efforts continue to receive, also furnish many piquant paragraphs to the newspapers. The Chicago Gas Companies—or some of them—were patriotic, or prudent, enough to contribute the handsome sum of $50,000 to the funds of the Exhibition Executive; but when, in return, some authoritative acknowledgment of the gas industry was asked for, the same Executive became impracticable. We alluded a short time since to some of these troubles of our American cousins, and ventured to condole with the many good, practical, straightforward, and common-sense men whom we know to be engaged in the gas industry of the United States, upon the garbled way in which, through the inveterate striving of American journalists after the "picturesque" style of reporting, news of their doings reaches the world at large. Our gentle criticism has been taken in good part. To our request for reports in plain English, one journal devoting itself to the American gas interests proudly rejoins that this is its special care. In its very next page, however, our contemporary, desiring to be plain, tells how "the "American Gaslight Association sailed close to the reefs "on Thursday, Oct. 22, 1891, and that it did not scrape "some of the copper from its bottom, or meet even worse "disaster, is not to the credit of the men elected to handle "the helm on that day." We have heard a corporation defined as having neither a soul to be—condemned, nor a body to be kicked; but this particular Corporation is here described as not only possessing a bottom, but also as having that bottom coppered! And then, if it was "not to the credit" of certain men that disaster did not happen to this curiously-built Association, are we to understand that it would have been greatly to their credit if the mysterious injury already mentioned had accrued? Really, unless it is seen to before it is too late, writing plain English will become as impossible for an American journalist as it well-nigh is already for a plain Englishman to understand American. All the same, we gather, from the reports that reach us from time to time, that our American cousins have a few little troubles of their own just now, from all of which we sincerely wish them safe and speedy deliverance.

Title and Index to Volume LVIII.—The title and index for last half-year's volume of the Journal is in course of preparation, and will be ready for issue next week.

Books Received.—"Methods of Gas Analysis," by Dr. W. Hempel, translated by L. M. Dennis (London: Macmillan and Co.). "The Strange History of a Dynamo," by T. E. Gatehouse (London: Alabaster, Gatehouse, and Co.).

WATER AND SANITARY AFFAIRS.

The Imperial power has at last interposed, to place the Metropolitan Water Question upon the footing which its importance demands. It is announced that Her Majesty's Government have resolved to advise the appointment of a Royal Commission to inquire as to the adequacy of the present water supply of London; and, if inadequate, the means of increasing the supply. This at once effects an essential change in the situation. The "Agreed Bill" of the County Council and the Corporation (we name the County Council first as having the master-hand) should now be laid aside, after making perhaps a brief appearance in the House of Commons, supposing the opposition on Standing Orders to be ineffectual. The protracted and strategic agitation which has been so long maintained respecting the water supply of London, must of necessity be suspended while the subject is being investigated by the high authority about to be appointed. From no quarter can a single voice of complaint be raised concerning the arrangement now pending. A full year ago, the County Council asked for a Government inquiry to be instituted —a request based on a unanimous resolution. Later on, when the Select Committee of which Sir Matthew White Ridley was appointed Chairman declared it to be "the "duty of the London County Council" to conduct a "complete inquiry" into the subject of the Metropolitan Water Supply, the Council demurred to the proposal on the ground that they had no power whatever to call for evidence or information, but would be entirely dependent on voluntary witnesses. Under such conditions, it was observed that the result of any inquiry the Council might make would fail to be final and conclusive. As for the report of the Select Committee, that suffers no slight. The Committee found the subject which they had to deal with was too big for their grasp, and required more time for its consideration than they were able to command. Having rejected the Water Bills of the Corporation and the Vestries, the Committee left the main task altogether unfinished, and practically untouched. A power adequate to the purpose is at length coming forward; and the people of London have every reason to be satisfied that a question in which they are so vitally interested is to be inquired into by an authority which they can trust. The conclusion to be arrived at by the County Council was obvious beforehand; and yet, in the absence of a Royal Commission, it was inevitable for the subject to fall into the hands of that body.

The full instructions to be embodied in the Royal Commission are not yet known. All we are told is that the inquiry will have reference to the "adequacy of the "present water supply of London." If the present supply is considered inadequate, then comes the question as to the means of increasing it. There is no allusion to the quality of the water, though this will inevitably receive consideration. Should quality fail, that, of course, would be as bad as no water at all. But there is no reason to apprehend this. The thoroughly wholesome character of the water sent out from the works by the London Companies is proved by scientific examination and physiological experience. With respect to quantity, there can be no dispute that an average of 31 gallons per day to each member of a population exceeding 5½ millions is adequate. Such is the "present" state of things. But the Commissioners will look into the future. We must understand the problem to be simply this: Can London, over a considerable series of years to come, be adequately supplied with water from the present sources? Or must a supply be drawn from remote watersheds, such as may be found in Wales or Devonshire? The sources now drawn upon yield an average through the year of 175 million gallons of water per day; the actual delivery being very considerably higher on occasions of summer heat. An attempt is made to show that the existing sources of supply are overtaxed. If they are, this must be due to defective works; for there is evidence to prove that an immense volume of water runs to waste in mischievous floods, while a large quantity escapes underground. The Rivers Pollution Commissioners, in their report on the domestic water supply of Great Britain—a document coming down in date to May, 1873—say: "We "believe that, within 40 miles of St. Paul's, a sufficient "volume of deep-well and spring water can be obtained "for the present daily wants of the Metropolis, and that

"the radius of the circle of supply would only require "to be very slowly lengthened to meet the requirements "of an increasing population." Reasons for this opinion are given at some length. Farther on, the Commissioners say: "Certainly no necessity can for a long time arise "for going beyond the 50-mile circle." From this reckoning, the chalk beds in the neighbourhood of Brighton are excluded, as not being within the Thames basin. Now, although it is nineteen or twenty years since these conclusions were arrived at, the interval is not sufficient to destroy their practical value. It is simply a question of going farther afield from time to time within the boundary of the Thames watershed. To disregard all this immense store of water close at hand, and to construct enormously expensive works encroaching on another watershed, would seem to involve a mistake from which London should be delivered by the acumen and impartiality of the Royal Commission about to be constituted. If, indeed, it is thought needful to visit the mountains and moorlands, and to draw from head waters and lakes, the subject then becomes one of national importance, and the right appropriation of watershed areas will have to be provided for. But let the issue from this point of view be what it may, we cannot suppose that a Royal Commission will advise any arbitrary dealings with the London Water Companies, who have maintained an abundant and healthful supply of water for the use of the enormous and rapidly increasing population of London and the far-off suburbs.

The City Commissioners of Sewers have finished their artesian well, and the trust which appertains to the enterprise now dawns upon them. They will be enabled to supply their artisans' dwellings at a cost of £150 per annum, instead of paying £80 per annum to the New River Company. The daily supply will only be at the rate of 20 gallons per head; and the estimated cost makes no allowance for a duplicate engine, or for depreciation of machinery. There will be a surplus volume of water; but the Solicitor to the Commissioners says they can only give it away. How this is to be done is not very clear, for the Commissioners have no power to pull up the streets to lay down water-pipes; and it is scarcely likely that the citizens will go with buckets to the City well, after the manner of a remote ancestry. Neither can we suppose that the Commissioners will send round a free gift of water, in the shape of a barrel on wheels. In the interest of the public and of the ratepayers, the best thing the Commissioners could do would be to make a present of the well to the New River Company, or sell it to the Company cheap. This would be a saving equal to the difference between £80 and £150 per annum.

Mr. John Holliday, Assistant to Mr. Hepworth at the Carlisle Corporation Gas-Works, has been appointed Sub-Manager of the Scarborough Gas-Works—a position for which applications were invited in our advertisement columns early last month.

The London Water Supply.—Her Majesty's Government have resolved to advise the appointment of a Royal Commission to inquire as to the adequacy of the present water supply of London; and, if inadequate, as to the means of increasing the supply.

Dr. S. Rideal, Lecturer on Chemistry at St. George's Hospital, who has from time to time appeared as a contributor to our columns, has just been appointed Gas Examiner to the Bromley (Kent) Local Board. We understand that Dr. Rideal is one of the candidates for the appointment of Gas Examiner to the Corporation of London, rendered vacant by the death of Mr. Charles Heisch.

Death of Mr. J. Douglas.—The death is announced of Mr. John Douglas, C.E., for some years Engineer of the Portsea Island Gas Company, but latterly Manager of the Victor Cement Works at Cowes. Mr. Douglas's health began to fail in 1875; and this caused him, four years afterwards, to relinquish his position with the Portsea Island Gas Company, in which he was succeeded by Mr. S. B. Darwin.

Death of Mr. John Chapman.—We regret to record the death, on the 10th inst., after a few days' illness, of Mr. John Chapman, of Harrow. Mr. Chapman was one of the founders of the Harrow Gas Company, of which he was Deputy-Chairman at the time of his death; and he was among the first members of the Harrow Local Board. He had been for 30 years a Guardian of the Poor of the parish, was one of the Superintendents of the Harrow Baptist Sunday Schools, and took considerable interest in all local institutions. Being so well known in Harrow, Mr. Chapman will be much missed; and great sympathy is expressed by all classes for his widow and family in their bereavement.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 123.)

During the past week the Stock Markets have been decidedly dull. At the same time there is no sign of any appreciable degree of weakness; and prices have not suffered any fall worth speaking of. It is difficult to understand exactly why this depression should be; for its source is not apparently among the phenomena which ordinarily furnish the cause of a depression. Money is cheap and abundant; trade and traffic at home are promising; the peace of Europe (always a hazardous thing to speculate upon) really seems ensured for some little time to come; and yet the markets are depressed. Perhaps those are not far wrong who think it is the prevailing sickness which prostrates our minds and unfits us for enterprise. If this be so, a revival of activity cannot be looked for yet awhile. The Gas Market, however, during the past week has been as active as it was in the preceding. Movements are irregular. The turn downwards in Gaslight "A," which was just beginning to show itself, has been more persistent. The opening price was 225. But this was not touched again; and the figures fell away gradually, until on Saturday the lowest point—219—was reached, without any promise at the close of present recovery. Nothing was done in the debenture stocks; but the "K" 6 per cent. preference was pretty active, and the price was well maintained. Of the two limited issues, the "B" 4 per cent. advanced 1, and the "H" 7 per cent. receded to an equal extent. At current prices, the one returns 3s. 8d. per cent. for money more than the other. South Metropolitans have not furnished much business; but the transactions marked in the "A" and "B" were all at good figures, indicative of strength. Nothing was done in Commercials; but a favourable tendency was apparent from buyers offering a higher price for the new stock. Transactions in the Suburban and Provincial Companies were at fair average figures, with the exception of one "special" bargain in Brighton and Hove, which, for some reason or other, was done much under the mark. The Continental undertakings have been doing very well; and perhaps the prospects of the preservation of the peace of Europe had something to do with it. Continental Union made a further advance of 5; and Imperial Continental, 3. Indians were quite steady. Of the South Americans, San Paulo receded ½. The improvement in Water quotations still continues; and further moderate advances have been scored.

The daily operations were: The Gas Market was fairly active on the opening day; and prices generally (with the exception of Gaslight "A," which fell 1½) were good. Continental Union gained 5; and Imperial Continental, 1. In Water, East London and Grand Junction rose 1 each. Tuesday was much quieter; and the only feature was a further fall of 1 in Gaslight "A." Lambeth Water rose 5. On Wednesday, Gaslight "A" was steady. "B" rose 1; and "H" fell 1. In Water, Chelsea improved 2½; and East London, 1. Thursday was very inactive. Commercial new rose 2½; and Imperial Continental, 2. But Gaslight "A" fell 2. Friday's business was almost entirely in Gaslight "A" and Imperial Continental; but neither moved. Saturday developed no fresh feature; and all quotations closed unchanged.

ELECTRIC LIGHTING MEMORANDA.

The Dessau Central Station—Gas-Engines for Central Electric Lighting Stations—Steam-Power Central Stations—The Difficulty of Understanding Electrical Measurements.

The particulars relating to the central electric lighting station of the German Continental Gas Company at Dessau, which we have recently given in the Journal, form an important contribution to the available stock of information respecting the installation and equipment of establishments of this kind, which will be specially welcome to gas engineers, from the mere fact that the whole thing is the production of distinguished members of the same profession. We have always maintained that if anybody can make a central electric lighting station pay, it will be a gas engineer, simply because he can bring to bear upon this class of business a wealth of practical experience and aptitude in management which no mere electrician possesses. The recent history of the electric lighting industry proves over and over again that its practical, working success has only been rendered possible by the labours of workers who have begun where the electrician, pure and simple, has left off. While it remained in the hands of electricians, the arc lamp was a sort of philosophical instrument; and the same might be said of methods of electrical generation and distribution. Gramme, Brush, Edison, Westinghouse, Ferranti, were all fully employed for years in putting the delicate apparatus of electricians into work-a-day garb. So, likewise, it was only when the ordinary run of mechanical engineers and gas-fittings manufacturers took to the electrical branches of their business, that the small goods of the industry assumed a marketable shape. Hitherto the design of central stations has been left too much to professors of electrical science, and to engineers whose ideas are those of the mechanical workshop; and how many of their productions in this line are likely to pay? It is not saying very much to assert that an

experienced gas engineer and manager, with an electrician assistant, would probably make at least as good a job of a central electric lighting station as gentlemen of the orders named. At any rate, no British municipality owning gas-works, and constrained to embark upon an electric lighting speculation, can afford to ignore the Dessau example.

We are as firm as ever in maintaining the position that British statutory gas companies had better have nothing to do with electric lighting; but, of course, we cannot pretend to lay down the law for foreign companies, the managers of which ought to know their own business best. The relations of Continental gas companies, working under the concession system, to the municipalities of the towns they have to serve are very peculiar and complex; and, altogether the position of a concessionary gas company with regard to electric lighting is, in some parts of the Continent, very much more like that of a British municipal gas department than that of a British statutory gas company with respect to the same business. This being understood, it is clear that if the administration of a municipal or sub-municipal gas undertaking think fit to establish an electric lighting branch, it is natural that the possibility of driving the electrical plant by gas, and so "killing two birds with one stone," should appeal to them for particular consideration. This is an idea that would never occur to a college professor, or to any of the well-advertised specialists who are usually consulted in a matter of this kind by a British municipality. Something of the sort has been suggested in Glasgow, however, with the immediate result of hopelessly confusing the ideas of all the eminent electrical specialists engaged to advise the Corporation. The illustration of Dessau is such a potent one, and the difficulty of wrestling with the "load factor" is admittedly so great in the case of steam-power stations, that any gas-supplying municipality who neglect to convey to their electrical consultants a special "Instruction" to consider the question of generation by gas-engines, will be guilty of a gross dereliction of duty.

With reference to the subject of the preceding paragraphs, it is possible to argue that when the equipment of large stations is in question, the comparatively small sizes in which gas-engines are at present made, as compared with steam-engines, bars the former from strict comparison with the latter. It is becoming apparent, however, that cases in which very large steam plant can be profitably employed in electric lighting must be exceedingly rare. In many towns there are small *nuclei* where, for the purposes of either business or amusement, a certain demand for electric lighting can be depended upon. Here is the opportunity for the gas-engine station. Even the steam stations (according to what has come to be regarded as the best and safest English practice) are split up into medium-sized generating units consisting of a high-speed engine coupled to, and driving its own dynamo direct. The notion that there is any special economy, for electric lighting work, in very large steam-engines, is one of the early delusions of electricians, which they are quietly but deliberately dropping. The employment of large engines driving big dynamos for generating alternating currents of high voltage is already seen to be a mistake—not, perhaps, so much from the point of view of the electrical engineer, as on account of other considerations. The question of the provision of transformer stations is by no means a simple matter to settle, having regard to the ordinary conditions of town life; and when Mr. Justice Kekewich forbade the reinstatement of the Grosvenor Gallery transformer station, on the ground that it would be a dangerous nuisance, his Lordship's decision went a long way towards settling the problem of safe and convenient electrical distribution.

The fact that conscientious electricians are at their wits' end to explain electrical phenomena and measurement, is continually being commented upon and deplored in the journals devoted to the industry. Our contemporary the *Electrician* has recently been devoting some attention to this puzzling subject, with special reference to the curious feature of electrical meters that they measure something which has no objective existence. When one measures water by means of a meter upon a pipe discharging into a tank, there is the water to show what the meter has been registering; and if there is any doubt about the indications of the instrument, the water can be measured out as easily as it was measured in. So also with the counting of a crowd of people by means of a turnstile giving access to an enclosure—the people are there, in evidence of what it was that made the "wheels go round." But when it is a case of measuring what is conventionally termed a "current" of electricity, where is it after it has affected the measuring apparatus? It only exists in flowing (if such a lame expression is permissible); and we only know that it is affecting the wire, or whatever the form of apparatus that contains it, not by any disclosure of itself, but by some indication which is really a factor of the wire or the apparatus. The analogy of electricity to flowing water is the only known means of expressing in simple language, not what electricity is, but what it does. It does not carry one far, however, even with dynamical electricity, although it is sought to explain the phenomena of induction by further assuming the water to be infinitely heated. And the "flow of water" analogy fails entirely to explain the most obvious phenomena of magnetism. It is therefore easy to perceive why electrical measurements are so misunderstood, or so seldom understood at all, even by people with a good aptitude for figures.

THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

The Electrical Exhibition which is now, by a polite fiction, described as being "open" at the Crystal Palace must naturally attract the attention of the gas engineering world; and accordingly we propose to describe the principal exhibits with particular care in the pages of the Journal, in order that our readers may be able to form an opinion as to whether it is or is not worth their while to personally inspect the show at Sydenham, and also that those whom circumstances may prevent from making the necessary pilgrimage may suffer as little as possible from the deprivation. We shall therefore, in all probability, devote several articles to our proposed critical notice of the exhibition; beginning as soon as there is anything ready for examination. When we visited the Crystal Palace last week, however, appearances indicated that, after opening the subject generally, it will be necessary to allow an interval of a week or two to elapse before instituting anything like a critical investigation of the details of the display. Enough may even now be seen, however, to give one an idea of the character and extent of the exhibition, which is the first thing to be considered. For there are exhibitions *and* exhibitions, as it is hardly necessary to prove by citing modern comparative examples which will occur to our readers' recollection. There is the exhibition which is a worthy representation of the condition of the *technique* of an industry, or a group of industries, as existing in a particular nation or in the civilized world; and there is the show which is merely a "catch-penny" concern, and merely caricatures the title which its promoters have chosen to give it. Between these extremes lies a wide range of speculation, which is filled in variously by the large class of exhibitions that are laid out to "combine business with pleasure" in uncertain proportions. It may be said at once that the Crystal Palace Exhibition is a high-class affair, worthy of the reputation of this really national, though actually proprietary, institution. It is supported by the full strength of the electrical engineering interest in this country, and consequently deserves to be esteemed as in every way fittingly representing the present condition of the electrical industries of the United Kingdom. This is no small thing to say; but we do say it without reserve.

The fact that the exhibition has been opened before it is ready or fit to be seen, is only what experience of undertakings of the kind leads one to expect; and the equally obvious fact that this particular example is even more than usually behindhand must, we suppose, be explained by reference to the nature of the exhibits. For it is no libel to accuse electrical apparatus of a trick of disappointing its friends just when they want it to make the best possible appearance before the world. Let this subject pass with the observation that in the present preliminary notice of the exhibition we shall not bind ourselves to draw the line too strongly between what is to be seen now and what may be hoped to be visible at the Palace before the season closes. Gas engineers, at any rate, will see no reason to grieve overmuch because a week after the date of the opening many of the exhibitors may still be seen getting their stalls in order by the light of an ordinary theatrical "T standard" which helps to swell the revenues of the Crystal Palace District Gas Company. We shall not wonder if the show, as a whole, turns out to be as good a thing for this Company as if gas apparatus had been formally included among the exhibits. Last week, at any rate, there was practically as much gas as electric light in evidence at the Palace.

The exhibition will be distinctly national in its scope and character. According to the catalogue, all the best known firms in the English electrical trade are to be found among the 230 or so stall-holders; and no foreigners worth mentioning appear in the list. There are, of course, several firms of foreign origin; but these have all become acclimatized ere this, and their work is accepted as forming part of the English branch of the industry. We have no hesitation in conceding that the general aspect of the interior of the Palace even now bears witness to the distinctiveness of this branch. There is a massiveness about the exhibitors' preparations, an absence of trickery from the setting forth of what they have to show, and a finish about their exhibits which unmistakeably stamp their origin. English electrical engineers may not be cunning in the employment of plush and satin hangings in the supposed adornment of a stand of dynamos; and the palm-trees are kept away from the steam-engines, which was not the case at Frankfort. But the apparatus looks like standing wear and tear; and wherever neatness and high polish may reasonably be sought for, there they are to be found.

The critical visitor cannot help comparing the general aspect of the Palace now with its appearance ten years ago; and the difference is easily noted. Where electrical engineering was obviously experimental then, it is not less obviously commercial now. What ten years ago was more of a curiosity than anything else, is now a matter of business. There is no disputing this conclusion. But it is equally plain that the development of electrical science and practice during the past ten years have not been precisely along the lines seemingly laid down at the commencement of this period. It is a significant fact that while the exhibitors in the long naves of the Palace are getting their stands in order, and while the arc lamps belonging to the lighting system of the building are shining all over the place, the

well remembered lines of gas-burners along the springing of the lofty roof are still alight, albeit, as it were, in the background. Is it unfair to compare the gas at the Palace to the garment next the skin, which a man never displays as an ornament, but which he can worst spare?

At any rate, if one had assured the electricians and the public ten years ago that gas would be found at the end of the decennium—not only holding its ground, but with the same old burners to light the Palace in case of emergency—the prediction would have been scouted. It would have been wrong to have met the boastful prophecies of the electricians at that period with a flat denial of their prospects of doing any business at all; but it is not a little remarkable that events have taken their actual course. For the permanence of the old nave gas lighting at the Palace is emblematical. Inasmuch as the design of the electricians of 1882 was to supplant gas, they have utterly failed; but they have as certainly succeeded in building up a business in many kinds alongside, and even in conjunction with, gas. A very great deal of the contents of the present exhibition, even when connected with lighting, speaks of applications with which gas has no concern. Search-lights, projectors, ships lighting of all sorts, and the machinery therefor, fancy lighting for the drawing-rooms of the wealthy, decoration in which tiny lights constitute an element—all these form whole departments of industry, into which gas has never entered. The extensive display of gas-engines applied to the driving of electric lighting machinery, again, is proof of the extent to which the one industry directly helps the other. And by far the most striking portion of the exhibits is composed of electrical apparatus applied to purposes other than lighting, such as telephony, telegraphy, and the accessory industries.

The long line of the naves is fairly filled with the most attractive descriptions of electrical exhibits, conspicuous among which are the stands of the Edison-Swan Company, Messrs. Woodhouse and Rawson, Messrs. Crompton and Co., Siemens, and the Brush Company. Here are also the electric telegraph exhibits from the General Post Office; the large stand of the National Telephone Company; and the cable exhibit of Messrs. Johnson and Phillips. Not all the telegraph and electrical signalling firms are exhibitors; but in exchange for these appear numerous exhibitors of electrical "sundries," whose name and fame are not particularly well known. This is really one of the striking features of the exhibition—the number of new electrical machinery and fittings' manufacturers who, according to the display they make, do a considerable trade in this way. From what may be seen here, it would appear quite unnecessary for anybody intending to make use of the electric light, or any other application of electricity, to go to one of the much-advertised companies or firms who have essayed to usurp pre-eminence in this department of industry. The gas-fitters as well as the ordinary engineering shops have clearly got hold of the "knack" of electrical fitting, and are running the professed electricians very close indeed.

The steam and gas motors required for the exhibitors of lighting, &c., or merely intended to be exhibited on their own account, are collected into a "machine-room" which, thanks to the vastness of the Palace, need not be entered at all by ordinary visitors, and consequently cannot prove a source of annoyance to people who are not interested in machinery in motion. This is the dingy corner immediately to the right of the entrance to the Palace from the High Level Railway Station, in which space is found for 38 exhibitors, who will doubtless all be ready for inspection in the course of a few weeks. At present, while some of the gas-engines are actually at work, a good deal of machinery is lying on the floor precisely as it was dropped from the carriers' carts.

The catalogue of the exhibition constitutes for the present the best guide to an appreciation of the scale upon which the undertaking will eventually be completed. This catalogue is sprinkled with little essays, introductory to the different divisions of the subject matter, by the Editor (Mr. H. J. Dowsing), who begins by telling the world that "Steam has revolutionized the present century; but electricity bids fair to control the destinies of the next." To control destiny is rather a "large order," even for electricity; but one must not be too particular with regard to the style or the matter of a catalogue, which is a kind of publication that always reminds one of the auctioneer. In this case, the Editor is particularly careful that there should be no mistake respecting the main object of the present exhibition. Having regard to the fact that "few towns exist where the subject of electricity has not been discussed," and that deputations from municipalities are "constantly visiting works in progress to see the various systems employed," it is pointed out that "the present exhibition will afford an excellent opportunity for local authorities of every town and village to send their representatives to view, in one well-chosen spot, the latest inventions for commercial use." It seems almost superfluous to add that "the Directors will welcome such deputations, and afford them every facility in their power"—naturally. Besides, is it not perfectly true that "the Crystal Palace, while offering exceptional facilities for the carrying out of an exhibition of this kind, also lends itself to the social enjoyment of its visitors?" Certainly it is; and accordingly there is every reason to hope that "this happy combination of business and pleasure will ensure even a greater success for the present exhibition than that which attended the former one held ten years ago." Let us hope, at any rate, that there will be no repetition of the company-mongering which attended the last exhibition. The time is not propitious for this sort of thing, which, moreover, is a game that can hardly be played twice. There is likely to be plenty of sport, however, in the netting of orders from local authorities, many of whom must shortly "do something," or see their statutory electric lighting powers lapse; and the exhibition will doubtless form a capital decoy for the electrical fowlers.

The attempt of the Editor of the catalogue to give a popular explanation of the phenomena and laws of electricity, including electrical measurements, is about as futile as such attempts generally are. The writer gets sadly mixed up between "force" and "quantity," and only succeeds in conveying to his reader the impression that Edison is not the only electrician who does not understand Ohm's law, although he may be one of the few who can afford to say as much. Mr. Dowsing goes on to describe in their turns primary and secondary batteries, dynamos, and arrangements for distributing electricity; and it is in connection with the last-named division of the subject that one misses, with a sort of shock, the name of Ferranti. There is no mention of the Ten Thousand Volt System; and if we inquire what has become of the clever Engineer who invented it, Echo makes her customary and unsatisfying response. On the important subject of electro-motors, Mr. Dowsing is diplomatically guarded; and with respect to that of lighting, he is conventionally confident, not to say boastful. He is prudent withal; for, while prophesying the large future extension of electric lighting, he is careful to say little about its present cost. Electric heating takes a superfluous amount of Mr. Dowsing's attention; for, although three pages of the catalogue are occupied with his discussion of the subject, there are only two exhibits in the section, and these not of any great importance. Before dismissing the subject of Mr. Dowsing's really creditable catalogue, we may be permitted to refer to his statement on page 187, that, "on examination of the accounts rendered by the electric supply companies throughout the country, it is found that the average price paid for a lamp of 10-candle power is 12s. per annum, against 10s. for gas." We should like to have his authority for making this statement; but, in any case, it is as well to remind our readers that, even if the assertion is correct (which we do not admit), the gas pays a dividend of 6 or 7 per cent. on the invested capital, while the electric lighting pays nothing at all. When we return to this subject, it will be for the purpose of dealing with the contents of the exhibition in detail.

THE CHANGING CONDITIONS OF GAS SUPPLY.

EACH shortest day, as it comes round in the course of passing years, seems to give less prospect of the realization of a hope that was very general at the time the suppliers of gas first began to push the use of gas cooking-stoves. One of the advantages of securing an extended use of gas for cooking, it was claimed, would be a larger summer consumption, which would enable a greater output to be effected from any given plant; enabling the charge for interest on capital to be spread over a greater quantity of gas—thus affording a prospect of cheaper gas for the public, with a fair proportion of advantage for the proprietors of shares. The endeavours to secure a more extended use of gas cooking-stoves were attended with a fair measure of success, and were doubtless productive of some benefit to all concerned; but, after practical experience, the claim for a larger summer consumption quietly dropped out of sight. It is quite forgotten now. The usual experience is that the gas cooking-stove is at work all the year round, and that, so far from being shut off for the winter, it is, if anything, employed rather more during the cold weather, when a larger demand exists for warm food and drink than during the hot weather. No well-to-do household, for example, would care to sit down to a cold breakfast or lunch, of the kind that is in demand during the sultry days of August or September, during the foggy or frosty weather that we have experienced of late. So that, at best, the gas cooking-stove has only brought a regular all-the-year-round consumption. This, however, although not all that fancy painted it, is by no means to be despised.

With the gas cooking-stoves, gas-fires and warming apparatus have been introduced, and possibly to as large an extent. Some gas companies have not troubled to push their use at all, and do not supply them on hire; others, who are more enterprising, have put them on exactly the same footing as cooking-stoves. Several cheap and attractive patterns of gas-fires have been brought out; and this department has been largely advertised by frequent discussions on the subject of smoke abatement, and the advantage of smokeless fuel. Attention has also been directed to it, no doubt, by the increased price of coal and coke, as in most localities this advance has taken place without anything like a commensurate increase in the price of gas. If any rise at all has been made, it has been too trifling to attract general attention. The gas heating-stove is not likely to be employed during the summer to any extent worth noticing; and its use in the winter half of the year will depend upon atmospheric variations. A considerable fall in the thermometer will lead to a large and instantaneous increase in the consumption; while a low barometer will not be without its effect, as meaning damp and chilly weather.

With the use of gas cooking and heating stoves, there has also come in the adoption of gas-engines, together with the use of gas for special technical purposes. These applications for gas are, speaking generally, entirely independent both of the thermometer and of the barometer; and they are affected only by business considerations, which may necessitate a season either of extra time or of short time. Moreover, they are sufficiently numerous and diversified to give a fairly regular demand, regarded as a whole, throughout the year, with the exception of holiday seasons.

The changed conditions in the supply of gas that have been developed during late years, may be summarized as comprising the addition of a large regular all-the-year-round demand, and also of a comparatively important increased demand during cold or damp weather. The chief thing to be feared, under the former conditions, was fog. But now it seems that the results following a rapid fall of temperature may be even more decisive. It was always observed that cold weather increased the need for gas, as, in shops and various places, the practice of turning on the burners as a means of warming the air has prevailed. But of late years the effect of temperature has become much more important. A sudden spell of fog and cold, setting in simultaneously, will therefore try the resources of the suppliers of gas to a much greater extent now than formerly. And therefore a large reserve of generating, purifying, and storeage plant is necessary. The sharp lesson received twelve months ago led to considerable activity, in the way of extensions, during the past summer. But there were some who neglected the considerations just laid down, and comforted themselves with the reflection that the winter of 1890-1 was a phenomenal one, which would be followed, according to all the laws of probability, by a milder season for 1891-2. Yet, as it has turned out, the reserve plant was quite as necessary this season as it was last. For a few days it was even more so.

The great defect of ordinary gas-generating apparatus is its inelasticity. It is, of course, always worked at its maximum productive capacity. Anything less would mean increased working expenses. If more retorts are needed, they cannot be brought into working order at less than 24 hours' notice. The engineer goes to the works (say) on Monday morning, and finds more retorts are required. But these cannot possibly be of service to him as helping to meet the Monday evening demand. Indeed, he will be fortunate if they can be brought in to do anything for even Tuesday evening. Unless there is ample storeage, approximating towards the equivalent of 24 hours' consumption, by Tuesday evening the holders will run inconveniently low. The slightest reduction in supply or pressure is sure to be noticed; and, with every care, it may turn out that the distributing plant is not equal to the strain put upon it. So that the engineer cannot see his way clear towards Saturday night, and does not know where he may get to before then. It is scarcely necessary to add that all sorts of inconveniences generally make their appearance at or about the Monday in question. The supply of fresh coal fails; necessitating a falling back upon old stock, which means a dropping off in the rate of production. Some of the best hands in the retort-house are away ill; and the strappers who are put in their places do not like the work. And so a thousand-and-one worries could be enumerated, any of which might come in, just at the hour of extremity, to make matters worse.

The makers of water-gas apparatus have claimed that it is to a great extent free from this defect, which we have called "inelasticity." Whereas a bed of retorts can only be worked, with advantage, to something close to its maximum productive power, it is claimed that a considerable variation may prevail with the water-gas generator, without any practical effect on the cost per 1000 cubic feet of gas made. And instead of requiring 24 hours' notice, it is claimed that the generator may, starting all cold, be at its full producing power in about two hours. A more convenient opportunity of testing the value of such apparatus, in these respects, than that which occurred during the recent Christmas week could scarcely be afforded. It was stated during last summer that The Gaslight and Coke Company had erected water-gas apparatus on a fairly important scale. As compared with the coal-gas plant belonging to this large undertaking, it might possibly only represent a few units per cent of the total demand, and not be large enough to turn the scale, one way or the other, in the case of a sudden additional need for gas. Still it is to be hoped that, in due course, official information will be forthcoming as to whether or not the capabilities of the apparatus as a means of rapidly increasing the rate of production were tested, and to what extent the claims above noticed were realized in practice.

Meanwhile, the question of meeting any sudden variations in demand, at or about the season of maximum consumption, is one that may well receive the attention of gas engineers. It has already been observed that the evils of a short supply extend far beyond the mere loss of gas-rental. It is more than ever necessary that a full and ample supply of gas should be maintained, at all times and under all circumstances, and that this should be done without incurring any extraordinary expenses.

Dr. Tyndall, F.R.S., has resigned his position as one of the Metropolitan Gas Referees; and we understand that the appointment will probably be offered to Professor Rücker, F.R.S., of the Royal College of Science, South Kensington.

NOTES.

A New Industrial Agent.

In a recent issue of *Industries*, a short editorial article appeared drawing attention to what was described as a "new principle" in industrial chemistry—namely, the application of cold in manufacturing processes. The point of the article was strengthened by preliminary comments upon the modern development of the application of localized heat in manufacture, as in the electrical furnace, in which the heat is concentrated by special appliances upon the exact spot where it is wanted. It is asserted that the new idea of employing cold by special means, and for particular purposes in manufacture, constitutes a fresh departure which may lead to many profitable industrial developments. After references to the improvement of the sulphuric acid manufacture by the judicious application of cold at a certain stage, and to the purification of benzene by freezing it, the article proceeds to notice the stoppage of gas-mains by the deposition of naphthalene as one of the standing trials of the gas manager, the removal of which would be hailed with joy by both producer and consumer. It is mentioned that experiments have lately been conducted in Germany in which coal gas was strongly cooled before being allowed to pass into the mains, with the result that "water, benzol, and naphthalene were deposited, and subsequent stoppages thereby avoided." It is also remarked that, contrary to expectation, the illuminating power of the gas was only decreased by about 0·2 of a candle; and even this would be compensated for by the recovery of a larger quantity of bye-products. The general tenor of the suggestion is that the possibilities of the industrial applications of artificial cold, in gas manufacture as in other matters, are well worthy of attention, especially as it is a field in which there are at present only a few pioneers, "but which may be worked in the near future by the main band of explorers with a chance of success that, considering what has already been achieved, appears by no means despicable."

A Lesson in Ventilation.

In a paper on Ventilation and Warming appearing in the *Builder*, an illustration is given of the method of calculating the ventilation required for a public hall 80 feet by 35 feet, and 24 feet average height, seated for 400 persons, and lighted by burners consuming 300 cubic feet of gas per hour. Allowance is made for 3000 cubic feet of air per head hourly, with 1000 cubic feet additional for every cubic foot of gas burnt; making a total in this instance of 1,500,000 cubic feet of fresh air required hourly, or 416 cubic feet per second. This inflow of air requires to be accommodated with channels aggregating 208 feet of superficial area, if the rate of flow is to be kept down to the regulation 2 feet per second. The method of admitting the air is from behind a wooden dado 5 feet high, with suitable perforations at the top. For the removal of the foul air, openings are arranged in the ceiling, the space between which and the roof is converted into a foul-air chamber, divided into two compartments, each discharging into the open air by means of a suitable ventilator of the self-acting type, fitted with valves for the prevention of down-draught. The rate of discharge is 7 feet per second, involving the use of two 6-feet tubes. The fresh air is propelled into the chamber by means of a fan; and the pattern selected is a 48-inch Blackman propeller, driven by a 2-horse power gas-engine. Such a scheme of ventilation would doubtless be sufficient; but it may be questioned whether many examples of ventilation upon such a scale exist.

Magnesium Lighting.

The employment of magnesium as an illuminating agent has for some years been restricted to the production of "flashes" for theatrical and photographic purposes, for which the metal is more conveniently used in the form of powder than in the wire or ribbon prepared for popularly illustrating the brilliancy of its flame. Questions having arisen respecting the duration of the flash obtained by injecting powdered magnesium into a non-luminous flame, Dr. Eder has measured the luminous period by means of a blackened wheel turning with known velocity in the dark, and bearing two brightly-polished reflectors—one on the periphery, the other at the centre. When this arrangement is photographed by the help of the light of a magnesium flash, the result is an arc, long or short in proportion to the duration of the flash. With one-fourth to one-half of a gramme of the metal, the flash lasts from one-quarter to one-third of a second. The explosive mixture formed with 30 parts of perchlorate of potash, 30 parts of chlorate of potash, and 40 parts of magnesium, used in quantities of ½ gramme, gives much shorter flashes, the duration of which may be as brief as 1-80th of a second. The illuminating power of these flashes has not been determined; and nothing has been heard for some time of the magnesium lamp, which it was suggested might be made useful, for signalling and similar purposes, by dropping a stream of magnesium dust into a spirit flame.

A Free-Flame Furnace.

It is claimed that a step in advance in adapting fuel gas to industrial uses is made by the Pettibone-Loomis open-hearth furnace, which has been designed to burn the gas produced by the Loomis down-draught generator. In this furnace, which is suggested as a type of arrangements of the kind required for a variety of metallurgical or industrial purposes, the air and gas

are introduced together through conical ports in the side walls, which enlarge inwards, and being disposed at a tangent to the internal line of the walls, the resultant flame has a swirling movement, which ensures full development of the flame itself, and ample opportunity for radiation. This idea of delivering a heating flame tangentially is noteworthy, as consituting evidence of the practical value of Frederick Siemens's theory that live flame should never touch a solid surface, but should heat it by radiation in the first place; the only contact being with the spent products of combustion. The value of this principle has been proved in connection with open-hearth steel furnaces, and also in gas-retort furnaces; but it is by no means generally understood or applied in regard to industrial furnaces and the large class of ovens.

Institution of Civil Engineers.—At the ordinary meeting of this Institution last Tuesday, the following were elected associate members: Mr. Isaac Carr, Gas-Works, Widnes; Mr. T. Goulden, Gas-Works, Beckton; and Mr. A. Holden, Water Engineers' Office, Bolton. On the same occasion, Mr. Boverton Redwood, F.R.S.E., was elected an associate.

The Dessau Central Electric Lighting Station.—Referring to the translation of Herr von Oechelhäuser's report on the Dessau central electric lighting station of the German Continental Gas Company, given in the last two issues of the JOURNAL, we learn that the 120-horse power "Otto" gas-engine mentioned therein is now at work in direct combination with a Fritsche dynamo; and it has been running since the 25th of October exceedingly well, giving a perfectly steady light. The large engine makes less noise than the two 60-horse power motors did before; and it runs quite cool at 150 revolutions per minute with full load.

The Mixture of Gases of Different Densities.—Dealing recently in the *American Gaslight Journal*, with the subject of the stratification of gases, Professor E. G. Love remarked that the greater the difference between the densities of two gases, the more rapid would be their diffusion. This is contrary to what might naturally be supposed. The same property of gases which causes them to mix readily will prevent them separating again "unless chemical action or some other extraneous cause intervenes." The practice of adding water gas to coal gas commercially has met with some objection on the ground that the greater density of the former would cause it to settle out, and form a lower layer in the holder; or that the mixture having been once effected, it would not continue so. Professor Love says there is not the slightest possibility of this, as the gases will mix readily and remain mixed. He has had frequent occasion to make mixtures of coal and water gases on a small scale; and has found that with coal gas of a density of ·480 and water gas of a density of more than ·700, when the heavier gas was introduced last into the holder, a space of about two hours was sufficient to effect the perfect admixture.

Boiling with Coal Gas and Water Gas.—Some interesting comparative experiments on boiling with coal gas and water gas have been made by Herr Coglievina, of Vienna, with various types of apparatus used for cooking purposes in Austria; and his results are epitomized in the *Journal of the Society of Chemical Industry* from the *Journal für Gasbeleuchtung*, in which they were fully reported. The types of apparatus selected were: (1) A vertical boiler in common use, made on a French model, and furnished with two rows of flames; (2) the well-known boiler made by the German Continental Gas Company of Dessau; and (3) an Austrian boiling apparatus with triangular slit opening. The results stated below are for the best of each type. The temperature of the room throughout the experiments was 14° C. (57·2° Fahr.), the gas pressure was equal to 2 centimetres of water, and the amount of water used in each experiment was 1 litre. It was found that the quantity of heat (in calories) generated in each case per minute with coal gas was: French boiler, 16·9; Dessau boiler, 18·8; Austrian boiler, 14·28—mean, 16·66 calories. The quantity generated per cubic metre of coal gas used was: French boiler, 2186; Dessau boiler, 2384·6; Austrian boiler, 2093—mean, 2221·2 calories. Taking the theoretical heating effect of 1 cubic metre of coal gas as 5150 calories, these results show that the best types of apparatus have an efficiency of $(2221{\cdot}2 \times 100) \div 5150 = 43{\cdot}13$ per cent. Experiments were next undertaken with the object of investigating the efficiency of the same types of boiling apparatus when used with water gas instead of coal gas. It was found necessary to close the air openings, and to increase the gas pressure up to 6 centimetres of water. Under these circumstances, the results given below were obtained: The quantity of heat (in calories) generated per minute was: French boiler, 12·13; Dessau boiler, 13·14; Austrian boiler, 10—mean, 11·76 calories. The quantity generated per cubic metre of gas was: French boiler, 942; Dessau boiler, 1081·4; Austrian boiler, 1036·4—mean, 1019·9 calories. Taking the theoretical heating effects of 1 cubic metre of water gas as 2813 calories, these results show that the best types of apparatus have an efficiency of $(1019{\cdot}9 \times 100) \div 2813 = 36{\cdot}25$ per cent. The author is of opinion that the commonest fault in all types of boiling apparatus (whether for coal gas or water gas) lies in the fact that the flame only plays on parts of the bottom of the boiler. Improvements can best be effected by securing an even spreading-out of the flame.

COMMUNICATED ARTICLE.

LIGHTING.

By W. H. Y. Webber.

PART III.—A CRITICAL EXAMINATION OF MODERN PRACTICE.

(*Continued from p.* 66.)

From what has been already remarked, it follows that if it is impossible, for reasons of economy, to provide much light for a roadway, the smaller the luminous intensity, in reason, of the light-sources employed for the purpose, the more equable the effect. Conversely, the more powerful the sources, the higher must be the scale of lighting over the whole roadway. So that, in a sense, it is true that the more powerful the lights, the more of them we need. Again, if it exceeds a certain range of intensity, a lamp for street lighting must be screened from direct view, or it is worse than useless for its intended purpose. Having in mind, therefore, the accommodating power of the human eye for different degrees of illumination, it may be concluded that artificial lights for streets or roadways may well be of very moderate intensity; and that, this point once defined, multiplication of sources rather than intensification of powers is the simplest way of improvement.

If we take the case of an ordinary suburban road, and consider the problem of lighting it, from the starting-point, the first thing to be settled is the minimum luminous power to be allowed for the individual lamps. If it were only a case of what has been called in these articles "beacon" lighting, the smallest flame that can be relied upon to keep alight would serve the purpose, as is actually the case with some railway signal-lights. A street lamp is, however, required to do more than merely render itself visible. Wayfarers do not require to read newspapers in any part of the roadway; but they often need sufficient light for deciphering a written address on a letter or card, for writing a memorandum, for consulting a watch, &c. These wants are really the most exacting that occur to foot passengers in the ordinary way. Those of drivers of vehicles are similar; and their observations are naturally taken at a height of several feet above the ground level, which favours the light.

Now, observation shows that the requirements just enumerated are satisfied by street lamps exhibiting, at a mean height of 10 feet above the road surface, a gas-flame of not less than 12-candle power effective. This means for all qualities of coal gas up to and including gas of 16-candle power, a 5 cubic feet flat-flame burner in a well-cleaned, neatly-framed lamp. If with thin opal top glasses, so much the better; but the top of the lantern must in no case be opaque. For richer gas, the rate of consumption may, of course, be smaller; but the average luminous effect of the lamp should not be lower than 12 candles, after allowance is made for the glass. Such a lamp gives a good, cheerful effect over a radius of at least 50 feet, which may be taken as the area of what appears to the dilated human eye as bright lighting. At this distance, an address on a letter may be read with ease, which means that a passenger need not cross the road for the purpose when he happens to be opposite a lamp. Such lamps throw a distinct shadow on flags or asphalte at a distance of 100 feet; and if spaced not more than twice this distance, they afford all the light really necessary for purposes of vehicular or foot traffic in suburban roads.

In busier thoroughfares, and especially in streets where there are well-lighted shops, the street lamps must be thicker. For it is an almost paradoxical fact that shop light, although it appears to make the pavements brilliant, affords little or no assistance to the street traffic, as shopkeepers who desire to make their windows attractive recognize, by adding extra lamps on the kerb-line. The reason for this is the same that has already been given with reference to intensification of street lamps—it is the presence of higher *maxima* necessitating the elevation of the *minima*. Spots of roadway that would not appear too dark when a single gas-lamp supplies the brightest point in the field of vision, look impenetrably obscure by contrast with the glare from a brilliantly lighted window. Good street lighting, for central thoroughfares not specially devoted to shops doing an evening trade, would be afforded by 5-feet lamps at (say) 90 feet apart. When more light than this is required, it is preferable to employ 10-feet burners, beyond which it is not necessary to carry the process of intensification for ordinary thoroughfares, with the exception of street refuge lights. But even these may do more harm than good if too brilliant. Powerful lights demand high columns to bear them.

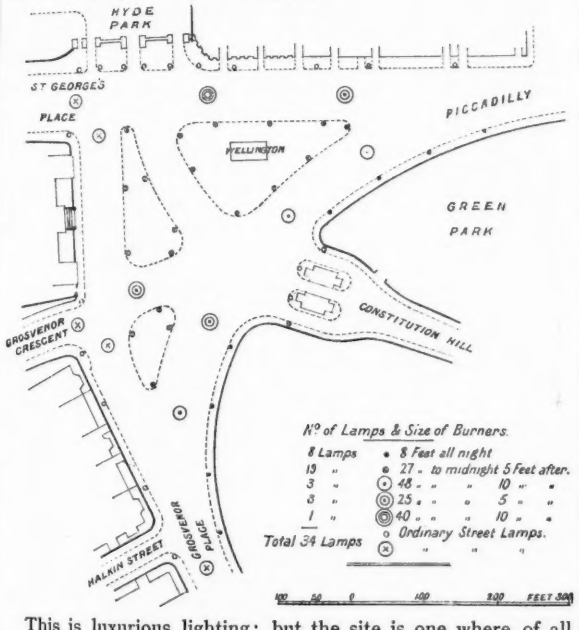
The ordinary 12-candle power street lamp, 10 feet high to the flame, gives on the ground immediately under the lantern an intensity equal to $12 : 1 :: 10^2 : x^2 = 1$ candle at (say) 2 ft. $9\frac{3}{4}$ in. distance. According to the formula already stated, a 24-candle, or a 10 cubic feet flame will give the same intensity of light upon the ground immediately beneath it from a height of 13 ft. 10 in., and so on. Since it is desired to increase the intensity of light on the ground, however, lamp-posts are not required to be further heightened in this proportion. It is to be observed, moreover, that street lighting from elevated lamps is, in reality, brighter than is shown by calculations according to the formula given, which show the value on the ground level, because the solid objects, moving and stationary, perceived by the light, stand up more or less from this level, and therefore tend to neutralize the effect of the Law of the Cosinus. This formula consequently gives only the minimum effect.

This part of the subject may fittingly conclude with one or two descriptions of good examples of street lighting by gas in the best modern style.

A Modern Example of Street Lighting in London.

The Gaslight and Coke Company have been honourably distinguished for their efforts to raise the standard of gas lighting in the streets of London; and they have from time to time organized displays of so-called "experimental" street lighting in different important thoroughfares of the City and West End. There is reason for thinking that these displays, which were in all cases carried out at the Company's own expense, or in concert with the firm of Messrs. W. Sugg and Co., Limited, were effectual in "putting a damper" on the rage for electric lighting upon the extravagant scale on which it was introduced in Paris. Although the "experimental" lighting arrangements were not finally adopted by the highway authorities, quite enough was done in this way to show the baselessness of the contention which the electric light speculators were anxious to establish—that, if better street lighting was wanted, there was no alternative to the arc lamp. This assertion of the electric lighting interest was so effectually met by the high-power gas-lamps, that to this day electricians never allude to this kind of gas lighting if they can avoid doing so, but always affect to compare arc lamps with 5-feet gas-burners.

The exhibition of these specimens of improved street lighting proved, among other things, that the amount of light which could be obtained for any thoroughfare was purely a question of expense; and so the electricians' attempt to assert a monopoly of brilliant lighting was defeated. At the present time, the pattern display of open-air lighting for London is that of Hyde Park Corner, the quality of which will be understood from the accompanying plan, courteously supplied for the purpose of this series of articles by Mr. G. F. L. Foulger, Distributing Engineer of The Gaslight and Coke Company.


HYDE PARK
ST GEORGE'S PLACE
PICCADILLY
WELLINGTON
GREEN PARK
CONSTITUTION HILL
GROSVENOR CRESCENT
HALKIN STREET
GROSVENOR PLACE
No of Lamps & Size of Burners.
8 Lamps • 8 Feet all night
19 " • 27 " to midnight 5 feet after.
3 " ⊙ 48 " " 10 " "
8 " ◎ 25 " " 5 " "
1 " ◎ 40 " " 10 " "
Total 34 Lamps ○ Ordinary Street Lamps.
100 50 0 100 200 FEET 300

This is luxurious lighting; but the site is one where, of all places in London, street illumination, upon a scale that would elsewhere be regarded as superfluously liberal, is a plain necessity. The rated consumption and the cost of gas are given in the following tabular statement:—

Total Estimated Consumption in Lighting the following Lamps with Cannel Gas (20 candles nominal).

Number of Lamps.	Before Midnight.		After Midnight.		Total Consumption.
	Size of Burner.	Consumption per Annum (2160 Hours' Burning).	Size of Burner.	Consumption per Annum (1676 Hours' Burning).	
		Cubic Feet.		Cubic Feet.	Cubic Feet.
Refuges . 3	48 ft.	311,040	10 ft.	50,280	361,320
" . 1	40	86,400	10	16,760	103,160
" . 3	25	162,000	5	25.140	187,140
Footways 19	27	1,108,080	5	159,220	1,267,300
" " 8	8	138,240	8	107,264	245.504
Total. . 34	..	1,805,760	..	358,664	2,164,424
Cost at 2s. 8d. per 1000 feet.	..	£240 15s. 4d.	..	£47 16s. 5d.	£288 11s. 9d.

Average consumption of gas per hour: Before midnight, 836 cubic feet; after midnight, 214 cubic feet.

The irregular shape of the area lighted, and the complexity of the traffic that has to be provided for, enhance the brilliancy of the effect, which must be seen to be appreciated. It should be remarked that the lanterns employed here are of special design.

(*To be continued.*)

TECHNICAL RECORD.

NAPHTHALENE IN ILLUMINATING GAS.

A Paper read by Herr E. Kunath before the German Association of Gas and Water Engineers.

[Translated from the *Journal für Gasbeleuchtung.*]

Naphthalene, a whitish substance, was first obtained from coal tar by Mr. Garden, in 1820. It was found to contain carbon and hydrogen in the proportion of 10 : 8; and the chemical symbol is therefore C_{10} H_8. It crystallizes in rhombic leaves, which are soluble in alcohol, ether, hot water, &c., but insoluble in cold water. The melting-point is 79° C; the boiling-point, 216° C; and the specific gravity, 1·15.

Having explained what naphthalene is, the next question of importance will be: Where is it formed? Some chemists are of opinion that the naphthalene which occurs in illuminating gas is formed in the retorts; others, however, do not consider that it occurs ready made in the gas, but maintain that it appears occasionally and locally in such places as are favourable for its production. As most gas managers will be aware, it is to be found in the ascension and dip pipes; so that there can be no doubt that the place where it is formed must be the retort.

As to the relations existing between the formation of naphthalene vapours and the heat of the retorts, chemists agree that, by raising the temperature, the quantity of naphthalene is increased. In practice, this supposition is found to be correct, as after the introduction of generator firing for retorts, the naphthalene trouble seems to have become greater than before. For my part, I have not experienced this increase of naphthalene in the gas-pipes; and this fact leads me to conclude that it is to be ascribed to the larger production of gas, at least in those cases where, with an increased make the condensing and scrubbing appliances have not been correspondingly enlarged. When, on the other hand, M. Lucien Brémond, in his valuable paper on "Naphthalene in the Manufacture of Illuminating Gas,"* says that it is not formed in the retort before a high temperature is reached, I cannot agree with him; for in 1857, when I was making some experiments on illuminating gas in Dresden, under the superintendence of Herr Blochmann, the naphthalene trouble was experienced at a time when we had not reached a very elevated temperature.

Before any better hypothesis as to the formation of naphthalene is suggested, we may suppose that the combination of carbon and hydrogen to naphthalene takes place in the retort, and that the naphthalene when formed is in a vaporous state. After leaving the retort, these vapours are condensed and crystallize. As you will be aware, all substances are subject to alteration of their condition by the withdrawal or the addition of heat. Ice, water, and steam, for example, are the different aggregates of one and the same molecular compound of oxygen and hydrogen (water); and it is only by altering the temperature that we change the aggregate. In the retort we have naphthalene vapour, and in the pipes and appliances crystals of the same substance; and we may suppose that there is also fluid naphthalene, since we know the condensing point of this substance to be about 79° C., or close to that of the tar vapours especially benzene (80° C.). Benzene, however, is a very good solvent for tar, as well as for naphthalene. Taking into consideration the fact that the specific gravities of naphthalene and coal tar are almost the same, we find an explanation of the occurrence of the former in the latter, which always contains larger or smaller quantities of it. The separation of fluid naphthalene, dissolved in benzene will therefore, in consequence of deprivation of heat about the mains and the dip-pipes take place to a greater extent the more uniform this deprivation of heat is found to be—in other words, the longer the gas remains in contact with the tar, by the great specific heat of which a rapid cooling is prevented. This has been termed, "hot condensation." It is natural that, from the vapours of the crude gas, there should first separate that part of the naphthalene and benzene the density, tension, and temperature of which are in a certain relation to each other; and from this it may be inferred that the vapours, supposing the decrease in temperature to be gradual, are always kept at the limit of their condensing points.

Now, in accordance with a law of physics, there is such a close relation between the density, tension, and temperature of all vapours, that any alteration of one of these factors must necessarily influence the others. In the manufacture as well as in the consumption of illuminating gas, we regulate the tension required in the apparatus and mains by the prevailing pressure; and, on the other hand, we influence the temperature by artificial or natural cooling, and thereby compel the density either to adapt itself to the given conditions, or to yield to an oversaturated state. In this anomalous condition, it requires but a trifling cause to change the aggregate; and as, in our special case, this alteration means deprivation of heat, the naphthalene vapours are consequently condensed to a fluid or a solid body. Such an impulse can be caused by rapid cooling; and while the benzene vapours are condensing and form fluid benzene naphthalene vapours, from their tendency to crystallize, pass directly into the solid aggregate, before uniting to form a fluid

* See Journal, Vol. XXX., p. 491.

To show this, we take a solution of common salt, saturated when hot, and allow it to cool down gradually and without motion. When cold, the solution will be in a state of anomalous tension, and the least motion—for instance, a grain of sand dropped into it—will suffice to cause a local cooling, and crystallization will take place instantaneously. The same phenomenon will be observed with water cooled down below its freezing-point while it is in a state of absolute rest.

If we consider that naphthalene vapours are readily absorbed by benzene vapours, or, in other words, are dissolved in them, we cannot but suppose that the formation of crystallized naphthalene will also take place, in consequence of the condensation of benzene vapours. This is the more feasible seeing that the separation of solid naphthalene is always initiated by local causes, as practice has shown. These in all cases prove to be deprivation of heat, either direct, such as cooling, or indirect, such as friction, changes of speed, or decrease in the diameter of pipes, &c. Moreover, under ordinary circumstances, the illuminating gas will always be saturated with naphthalene and benzene vapours and steam. The latter, however, is an excellent conductor of heat; and as it possesses the highest condensing-point, when the temperature is decreasing, it will condense first and deprive benzene and naphthalene vapours of their heat—thus causing indirectly the deposition of crystallized naphthalene.

M. Lucien Brémond endeavoured to find out the part that steam plays in the formation of solid naphthalene, by making experiments with dried illuminating gas; and he came to the conclusion that no naphthalene is deposited from dry gas. We made some similar experiments in our laboratory with undried and dried illuminating gas, and found that, from the former as well as from the latter, naphthalene can be deposited to such an extent that the pipe used was blocked. To try, by experiments on a larger scale, the effect of the removal of moisture from the gas on the deposition of solid naphthalene, the gas we were using in our works in Dantzig was dried by aid of two small boxes, of the shape of purifier-boxes, filled with chloride of calcium. The gas-pipes on our works fulfilled all the conditions suitable for the deposition of solid naphthalene. During the whole of the winter of 1889-90, the gas required for the lighting of the works (upwards of 100 cubic metres daily) was thus desiccated. The results confirmed our laboratory experiments, for the pipes remained free from such naphthalene deposits, which are the result of the presence of water, while each lowering of the temperature caused the deposition of this substance.

Some experiments made by Dr. Tieftrunk and Mr. Friedleben, the results of which showed that the deposition of naphthalene from gas bears a certain ratio to the presence of ammonia, entitle us to suppose that the removal of the latter from the gas means also the removal of naphthalene. In order to check this statement, ammonia was stored in a small gasholder, and the dried gas burnt on the works was mixed with certain quantities of it. As, notwithstanding the favourable winter cold, no deposits of naphthalene were to be effected with small quantities of ammonia, the amounts were gradually increased so as to get as much as 190 grains in 100 cubic feet of gas—*i.e.*, about a hundred times as much as is present in ordinary gas. There were no traces of naphthalene found in the pipes. Although I cannot agree in attributing influence to ammonia itself in separating naphthalene from gas, I partially admit the correctness of this observation, inasmuch as the separation of ammonia includes the removal of water.

Having completed these experiments with dried gas, I proposed, instead of taking the moisture, benzene, and naphthalene from the gas by means of a drying apparatus, simply to cool the gas. This was to be easily effected; the winter of 1890-91 being exceedingly cold. We passed the gas through a box constructed of tin plates, the surface exposed to the air being about 3 square metres. Two pipes, each 40 mm. in diameter, connected the box with the main. In the box there were two small glass windows, to admit daylight; and in the inlet and outlet of the box, two thermometers were inserted. The ratio of cooling surface and maximum of gas passed through the apparatus were favourable to the cooling of the gas down to 2° to 3° C. below the outside temperature. The apparatus was working the whole of the winter, and with the same results as the drying apparatus. The moisture was removed apart from the artificial drying; and therefore no pipes were obstructed or frozen. The box contained all the moisture and the condensed substances, which when warmed yielded an emulsion. On being allowed to stand for some time at about 15° C., a light yellow oil collected on the surface of the liquor. The quantity depended on the degree of cooling to which the gas was subjected. From one cubic metre of gas cooled down from 0°C. to—7°C., 1·71 cubic centimetres of water and 0·02 cubic centimetres of oil were obtained; and when the gas was cooled down to—11·5°C. or to—16°C., the condensed water amounted to 3·835, and the oil to 3 centimetres. The nearer the temperature approached the freezing-point of water, the less oil was condensed; but crystals of naphthalene were observed instead. Of course, the separation of oil, which, on the whole, consists of benzene and small quantities of naphthalene, reduces, however slightly, the illuminating power of the gas in question. We found this difference to be 0·2 candle—*i.e.*, the gas without the oil condensed showed as 17·6 candles, while the ordinary gas showed 17·8 candles. In these tests the differences in temperature were not taken into consideration. It does not matter whether moisture is removed by artificial drying or by natural cooling, the result with regard to the separation of naphthalene from the gas will be the same in both cases. If, however, cooling of the gas should be chosen for removing naphthalene, this can only be done by powerful condensation.

Our results therefore confirm those arrived at by Herr Pitschke who obtained naphthalene from dried gas, and are opposed to Brémond's assertion as to the part played by moisture. Moreover, supposing the naphthalene to be found ready made in gas, our results admit the further conclusions that, under similar conditions, it should not separate from dried and re-moistened gas when the former had once been freed from it, and that it should be deposited from the latter when the dried gas had not been cleared of it properly the first time. Experiments have confirmed the fact that from dried and re-moistened, as well as from dry gas, naphthalene may be obtained; and in the latter case the second tube in which the experiment was made only showed condensed water when the separation of naphthalene in the first tube had been completely effected.

I will now describe the apparatus, beginning from the inlet for the gas. It consists of a drying vessel, filled with chloride of calcium, a refrigerator, a water-pot, a tube, a second water-pot, a moistening arrangement, a second refrigerator, a third water-pot, a second tube, a fourth water-pot, a gas-meter, and a long pipe with a burner attached to it. Before the refrigerators, which have to maintain the gas at a certain temperature, there are thermometers inserted in the water-pots. The two tubes mentioned above were gas-pipes 10 mm. in diameter and 30 centimetres long; and they were placed in one box filled with ice, so as to keep them at the same temperature. The refrigerators were flat tin boxes, and could be dipped in water. The whole apparatus consisted of two parts, one of which was in connection with a drying, the other with a moistening appliance. The corresponding pieces of both parts had similar dimensions, so as to cause the gas to pass through them at the same speed. The first part had attached to it the drying apparatus; the second, the moistening apparatus. As already mentioned, these experiments confirmed our supposition, and proved that naphthalene occurs ready made in illuminating gas, and that it is the benzene in a vaporous state that causes naphthalene to separate in a solid form.

In order to work the apparatus, the following precautions are necessary: The gas used must be freed from moisture by slowly cooling it, to bring it to a density which is in proper ratio to the temperature and pressure of the gas. The first tube is to be placed sloping from behind, so as to cause the water separating out to flow back into the first water-pot. If this is neglected, no naphthalene will be obtained. I allude here to the fact that if naphthalene is found in gas-pipes, it is, as a rule, in ascending inclines; and where it occurs in descending inclines, the crystals have been drifted there by the current of gas. As to the decrease in temperature that effects the separation of naphthalene in a solid form, we have shown, by our experiments, that a difference of a few centigrades—nay, under especially favourable conditions, half a centigrade—will suffice to cause a deposit of crystals, supposing the deprivation of heat takes place abruptly. The occurrence of naphthalene in gas-pipes confirms this result so far, as some cases of obstructed pipes prove to have originated by such very slight lowering of temperature.

I will refer to a case which happened in my practice, and which may be interesting enough to be quoted. In a certain place where there was an ascending gas-pipe of 150 mm. in diameter, which was covered by earth to the extent of about 1·5 metres, an accumulation of naphthalene crystals was found one day without any assignable cause whatever, as all the other parts of the pipe were perfectly clean. On investigation, we found that only a few centimetres below a water-main was crossing the pipe; thus imparting a local refrigeration to it. In summer, the temperature of the gas was about 16° C.; that of the water, 10° C.—the difference in temperature being 6° C. In winter, the corresponding temperatures go down to 10° C. and 6° C.; and therefore the difference is 4° C. Such slight differences between the temperatures within and outside the pipes cool the current of gas but slightly, and yet they do so sufficiently to separate naphthalene from it. Therefore, for the separation of this substance from illuminating gas, no temperature below the freezing-point of water is required. The only thing necessary is a rapid decrease in temperature of a few centigrades; and thus it is easily to be understood that nuisances from naphthalene may happen at other seasons besides winter.

A question of considerable interest and importance to a gas manager now arises: Are there any means to prevent the formation of naphthalene? Before entering upon this subject, I will repeat that naphthalene is formed in the retorts as a vapour. By condensation, a portion of it is dissolved by benzene and runs off with the tar. The remainder is kept dissolved by the benzene vapours of the gas, and is not condensed before, owing to rapid refrigeration, those vapours drop (if the term may be used) the naphthalene. By removing the benzene vapours from the gas, we remove the naphthalene as well; and this can be done by condensation. To obviate the formation of naphthalene in the retort has not yet been practicable; and so we shall have to deal with it in the gas. Were it possible to get rid of it and the benzene vapours in the dip-pipes, the question

of naphthalene would be settled. This, however, is impossible by the means at our disposal, as the temperature of the surrounding air would not be low enough, not even in winter, to effect condensation; and any artificial cooling agent (ice, &c.) would be too expensive, if not altogether impracticable. Therefore, from the dip-pipe to the purifiers, we cannot use any artificial refrigeration save that by air or cold water. All we can do is to get rid of as much water, benzene, and naphthalene as we possibly can on the way. On the other hand, we ought to avoid any rapid changes of temperature in these mains which will cause the last-named substance to settle down.

The safest way of effecting this is to have a large condenser where the current of gas is cooled constantly, but not rapidly; thus eliminating moisture, benzene, and naphthalene. By taking the two latter from the gas, we cannot help lowering its candle power; but this we shall have to put up with in favour of the tar, which is enriched accordingly. If we wish to do better, we shall have to place a more powerful condenser behind the purifiers. This second condenser would not only dry the gas, but cool it down to a very low temperature; and on entering the main, the gas would be warmed, and take up moisture eagerly. This re-saturation would mostly occur in the station meter, which is situated between the purifiers and the mains; and consequently all the work would have to be done in vain. The water in the meters might be covered with some oil—petroleum, for example—to prevent the evaporation of the water; but this would probably destroy the joints of the meter, by dissolving the cement. Unless we find a substance that will replace the liquid in the meters without destroying them, we shall have to use a second condenser between the station meter and the main.

As I have already stated, the dry gas eagerly absorbs any moisture; and for this reason the pipes should be kept as dry as possible, and the water-pots be emptied very frequently, or, as this might be too troublesome, the water covered with petroleum. A careful person can pump out the water from a water-pot without removing the oil. To do this, the pump is dipped into the pot, the oil on top inside the pump blown out, and the water pumped. Farther on, the water in the wet meters would have to be covered with petroleum. Instead of water, the gas would then absorb petroleum vapours, which would cause an increase in its illuminating power, and also redissolve the naphthalene already deposited in the pipes. By a second condensation, we therefore avoid the trouble arising from the pipes being frozen and obstructed. If required, we may employ cooling by ice for a second condensation; but this is not absolutely necessary, as in winter the temperature of the air will suffice. In summer, naphthalene troubles are much less annoying than when the cold weather is coming on. In prolonged condensation, there is another point to be considered—viz., decrease in the volume of the gas; and thus the customers would be supplied with a greater quantity of light for the same money. This, however, would be compensated for by the saving arising from a less frequent use of tools for thawing and mending pipes, and from an increased consumption of gas, as no pipes would be blocked.

Before I conclude this paper, I will give a few hints for the prevention of choked pipes. The gas pipes and conduits should be kept as dry as possible, and the water-pots, &c., covered with petroleum. The time to begin is the summer, as then a good deal of the oil will evaporate and clean the pipes. To pump the water from the water-pots, a vacuum-pump should be used, and the water carefully drawn out. Gas-meters that serve pipes which run from hot rooms into the open air should be filled with petroleum. Pipes obstructed with naphthalene—not frozen ones—are to be cleaned with warm petroleum. To do this, a box should be used which is filled with warm petroleum, and connected by one tube with the choked pipe, while air is forced into the box by means of an air-pump. To the apparatus there is attached a pressure-gauge; and in order to warm the oil, the apparatus is placed in a tub filled with hot water. Such places in the line of conduits as are exposed to great changes of temperature should be covered by suitable substances.

In the course of some remarks upon the paper, Herr Hasse, of Dresden, said that pipes obstructed by naphthalene would appear at first when the days were beginning to shorten; and this time would coincide with an increased production of gas. During this period, the days would be still rather warm; while the nights would become gradually colder. The warm gas from the holder was kept warm in the earth; but when, in passing the conduits, it was exposed to the cold air in the evenings, it would be rapidly cooled down, and the pipes choked with naphthalene. So far, he was quite of the opinion expressed by Herr Kunath; but he also fully acknowledged the part Dr. Tieftrunk attributed to the vapours of tar and ammonia with regard to the absorption of naphthalene. The latter had proved that gradual refrigeration never caused separation of naphthalene from the gas; while rapid cooling, if by some few degrees only, sufficed to cause a deposition of naphthalene. This process was promoted by friction; for instance, when gas had to pass narrow pipes at great speed. Experience had fully proved this assertion. How far an increase in the temperature of the retorts, especially since the introduction of generator firing, might influence the formation of naphthalene, he would not venture to say; but, speaking generally, he was of Herr Kunath's opinion, that the temperature of the retorts could have but a slight effect upon it. The naphthalene nuisance had given rise to complaints from 25 to 30 years ago, when the production of gas per retort and per 24 hours was about 6000 cubic feet, and when this was considered an excellent output. When he (Herr Hasse) went to Dresden, it was about 3000 cubic feet per retort per 24 hours; and the formation of naphthalene, and the subsequent trouble, was worse than ever. Now the make per retort per day was as much as 9000 cubic feet; and complaints of obstructed pipes were not more frequent. In his opinion, the vapours of ammonia and tar absorbed naphthalene; and he thought Herr Kunath had not proved the contrary. When ammonia was artificially added to the gas, no naphthalene could be taken up, as what was present had been already combined with ammonia and tar. When, on the other hand, the gas, before entering the purifiers, was washed with dilute acid, to remove ammonia, heavy deposits of naphthalene might be observed in the station meters, the holders, or the gas-pipes. The only way of avoiding these deposits was to have efficient condensation; and, as Herr Kunath had observed, the gas should be cooled as slowly as possible. They had experienced this in the three gas-works in Dresden. Whenever the production had to be increased, and the condensers were not able to act thoroughly, there were obstructed pipes. In the new works, established ten years ago, no naphthalene crystals had ever been seen, whether in the purifiers, the meters, the mains, or the services. Not even during the severe winter of 1889-90, when quite two-thirds of the whole of the town had more or less to complain of the naphthalene trouble, the remaining part, which was supplied from the new works, never had any cause to do so at all. The first reason was that the new works were provided with some excellent condensers, which worked slowly and thoroughly; and the second was that this part of the town had large mains, so as to avoid friction of the gas as much as possible. That this was not unimportant was shown by the fact that when, in places where chokes occurred regularly once a week or so, the pipes were changed for larger ones, obstructions occurred much less frequently. As to the addition of benzene or petroleum to the purified gas, he (Herr Hasse) was of opinion that this would be of very little use, as the vapours would occasionally condense again. Benzene could not by these means become a permanent constituent of illuminating gas which would prevent the separation of naphthalene by refrigeration. In the winter of 1890-91, the naphthalene trouble in most places was as bad as it could be, while in Dresden comparatively little was heard of it. This had to be attributed to the fact that one of the three gas-works in the town had been enlarged, and the number of condensers nearly doubled, while the production of gas had not been correspondingly increased. The old works had subsequently been relieved; and thus the condensation of the three works had been improved. As soon as the supply came up to the former conditions, the naphthalene trouble would probably reappear, unless the condensers were enlarged. He had been asked how it was explained that the nuisance should have appeared so grievously with the introduction of generator firing for retorts. All he could reply was that gas-works in which generator firing was introduced were saved the trouble of increasing the number of retorts with the extended demand for gas. Therefore, while the production of gas became larger by working the retorts at a higher temperature, the number of condensers remained the same, in consequence of which condensation could not be anything like so complete. In practice, he found that, whenever the condensers were proportionately enlarged, the difficulty with naphthalene abated.

The Standards of Light Committee.—The first meeting of this Committee was held last Friday at Whitehall Place, and adjourned for a fortnight after the transaction of some preliminary business, including the selection of a Chairman. The constitution of the Committee (most of the members of which were present at the meeting) is as follows: Dr. W. Odling (Chairman) and Dr. W. J. Russell, of St. Bartholomew's Hospital, as representing the Board of Trade; the three London Gas Referees—Dr. W. Pole, Mr. A. G. Vernon Harcourt, and Professor Tyndall's successor when appointed; Mr. George Livesey, Mr. G. C. Trewby, and Mr. H. E. Jones, for the Gas Companies; and Mr. W. J. Dibdin and Dr. E. Frankland, nominated by the London County Council.

Determining Sulphur in Coal.—A method of determining the quantity of sulphur in coal has been proposed by M. Eschka. It consists in heating 1 gramme of coal with 15 grammes of a mixture of two parts by weight of magnesia and one part of dry sodium carbonate in a 30 c.c. platinum crucible, placed in a sloping position, so that only the lower part is red hot. The mixture is stirred two or three times in the course of an hour, at the end of which time the coal is fully burned off. Solution in hydrochloric acid, oxidation with bromine, and precipitation with barium chloride, complete the operation. It is found, the *Analyst* says, that no loss of sulphur occurs, and that, where several determinations have to be made, porcelain crucibles heated in a muffle for 20 to 30 minutes can be advantageously substituted for the platinum crucible and the Bunsen burner.

FUEL GAS: ITS PRODUCTION AND DISTRIBUTION.

A Paper read by Mr. Arthur Kitson before the Franklin Institute.

Fuel gas is not quite so recent a discovery as many people suppose. Half a century ago, M. Ebelmen described, in a paper read before the French Academy of Sciences, a method for utilizing charcoal *débris*, coal slack, and other carbonaceous refuse, by converting them into the form of gaseous fuel, which was conveyed to suitable furnaces, and there consumed. This process was operated with considerable success at the iron forges of Audincourt. Ebelmen's method formed the basis of nearly all the fuel-gas systems that have since been produced, and consisted in the partial combustion of carbon by forcing a limited supply of air, or a mixture of air and steam, into a furnace containing the solid fuel in a state of combustion. The gaseous products resulting from the gasification of charcoal by a blast of hot air consisted of—

		By Volume.	
Combustible . . .	Carbonic oxide (CO)	= 33·30	36·1 per cent.
	Hydrogen (H)	= 2·80	
Non-combustible .	Nitrogen (N)	= 63·40	63·9 ,,
	Carbonic acid (CO_2)	= 0·50	
		100·00	

With a mixture of air and steam, the products were—

		Percentage.	
Combustible	CO	= 27·20	41·2 per cent.
	H	= 14·00	
Non-combustible	N	= 53·30	58·8 ,,
	CO_2	= 5·50	
		100·00	

Twenty years later, the Siemens regenerative furnace was introduced; and the startling results achieved by its inventor in metallurgical work, rapidly opened a wide field for the use of fuel gas in the iron and steel industries. It was demonstrated that 7 cwt. of coal would do the same work that had hitherto been performed with a consumption of at least 2 tons of coke, in heating a ton of iron to welding heat; and 12 cwt. of coal, replaced 3 tons in melting a ton of steel by means of this gas, furnace. The success of fuel gas for metallurgical work was at once assured.

Until the supply of natural gas in Pittsburg had created a demand among domestic consumers for this desirable addition to modern household conveniences, there had been scarcely any attempt to provide private dwellings with any other than illuminating gas. It is true that some attempt was made in Germany to introduce a heating gas; and that, as long ago as 1862, a company was formed in Birmingham (England) to supply that city with fuel gas at a cost of 6d. per 1000 cubic feet. The Bill was actually presented to Parliament; but it was thrown out in Committee of the House of Lords, because their Lordships thought that, if the scheme was as good as represented by its promoters, existing gas companies would gladly engage therein. It is needless to say that the existing gas companies, already possessing the lighting monopoly of cities, did not care to undertake any experiments or embark in fresh schemes; and it was reserved for an individual 25 years later to put the first fuel-gas plant in operation for domestic purposes.

In America, progress has been more rapid, owing, undoubtedly, to the presence of natural gas. The great boon that the discovery and use of this gas has been to certain portions of the West, resulting in the foundation and growth of large and prosperous towns—a discovery that has brought health and happiness to thousands, besides enriching the districts where it exists to the extent of millions of dollars—has excited a demand for an artificial substitute where natural gas does not exist, that must sooner or later be supplied. Moreover, the long-predicted exhaustion of natural gas in those regions where lately it was most abundant seems nearing realization, as foreshadowed by the action of the Pittsburg companies in cutting off all supplies for industrial uses, and confining themselves to domestic consumers. Such districts cannot well go back to their old habit of burning coal direct. A substitute for natural gas is therefore inevitable.

The distinction that is made between fuel gas and illuminating gas arises chiefly from the difference in cost. Illuminating gas makes an excellent fuel gas, providing it can be sold at a price sufficiently low to allow of its use for fuel. In thousands of instances, both coal gas and carburetted water gas are used in cooking and heating stoves; but their uses as fuel are limited, owing to the cost of such heat. Fuel gas necessarily means cheap gas; and in order to take the place of solid fuel, it should not exceed the cost of coal at the place of consumption. Now, since the combustible gases generated from coal—whether by the process of distillation, as in the ordinary coal-gas system, or by the conversion of the carbon into carbon monoxide, with the addition of hydrogen from decomposed steam, as in the water-gas system—contain less energy than that from which the gases are obtained, it would appear at first sight impossible to replace coal by its gases, economically speaking. But when we reflect that, out of possibly 29 million units of potential heat contained in a ton of coal, we derive, in ordinary domestic uses, scarcely perhaps 5 million, whereas from 30 to 50 per cent. of the total heat of combustion of gas is readily available, it becomes evident that we can afford a good margin of loss for the conversion of coal into gas, and still achieve better results than with the coal itself. The saving of space occupied for coal storeage, and all the expense and trouble incident in handling coal and removing ashes, to say nothing of the cleanliness and healthfulness, are points of sufficient advantage to give to fuel gas a superiority, if even the economy were no greater than with coal. I do not mean to say that it is cheaper in all cases to convert coal into gas, and burn the gas, than to use coal direct. There are uses for which coal burned directly is the cheaper system. Such, I believe, is at present the case with the modern steam-boilers, where combustion is, in able hands, nearly perfect, and the products escape at a temperature not exceeding 500° Fahr.

In order to ascertain the cost of a gas, we must know, firstly, its composition; secondly, the purpose for which it is to be used; and, lastly, the price per unit of volume. Its composition gives us both its heating value and flame temperature. Having given the use to which it is to be applied, we may judge of the quantity we must consume to produce a certain effect. Finally, its price per 1000 cubic feet enables us to figure the cost at which we can do our work.

It may be useful at this point to call attention to the distinction between the calorific value of a gas and its calorific intensity, as there is a great deal of misapprehension prevalent on this subject. If we wish to select a gas for heating a substance to incandescence—a Welsbach burner or a Fahnehjelm comb, for instance—we need a flame of high calorific intensity; and we should choose uncaburetted water gas. If, on the other hand, we wish to boil water, we should choose natural gas; and next to that, coal gas. Of course, this supposes no difference in their cost. The calorific value of a gas is the sum total of the heat-units contained in its combustible constituents, irrespective of the diluents associated therewith—*i.e.*, heat-units per unit of volume. Calorific intensity is dependent not alone on the thermal units contained in the gas, but varies inversely with the weight of the resultant products of combustion of the gas multiplied into their specific heat.

Of all artificial substitutes for natural gas, that commonly known as water gas is by far the most popular, and claims the greatest number of advocates. Water gas is made, as most of you are aware, by forcing steam through a deep body of incandescent coal or coke. This action is alternated with that of blasting air through the fuel to regain the necessary temperature of combustion preparatory to again driving in steam. The steam is decomposed in presence of the incandescent carbon, forming carbon monoxide; the hydrogen of the steam remaining free. These two gases are given off in about equal quantities, and burn with a beautiful pale blue flame. The chemical transformation is conveniently represented by the equation

$$C + H_2O = CO + H_2.$$

This, however, is not the precise manner in which the transformations occur. Carbonic acid gas is first formed, and is converted into carbon monoxide in presence of more carbon. It is exactly represented thus:

$$4\,H_2O + 4\,C = 8\,H + 2\,CO_2 + 2\,C = 8\,H + 4\,CO.$$

Coal gas—that made by the retort system—has also its advocates as a fuel gas; but hitherto there has been no practical demonstration of its production at a price calculated to ensure its use as a fuel to any great extent. The returns from its manufacture and supply are based largely upon the sale of the bye-products—coke, tar, naphthalene, ammoniacal liquor, &c.—and the profits are, therefore, dependent upon fluctuating markets for these products, as well as the price of gas. This system pertains, therefore, rather more to what is commonly known as the chemical than to the gas industry. It has been proposed to convert the bye-products coke and tar into gas, and mix with the distilled gases; but this virtually brings the system within the class of water-gas systems, since the solid fuel (coke) would be treated by the ordinary water-gas process. Moreover, it is quite possible to carry on the process of distillation and the water-gas process in one and the same generator, and so avoid the extra labour and expense which the retort system entails.

Let us now investigate the methods described for gasifying coal for fuel purposes, in order to ascertain in what way we are likely to achieve the best results. We may conveniently divide them into three classes—viz., water gas, semi-water gas, and producer gas. The first is known as the alternate system, in contradistinction to the last two methods, which are continuous.

Taking the first method described by Ebelmen of gasifying carbon—viz., forcing a blast of air through a deep bed of the ignited fuel (producer gas), you will see by the table above given that we only get about 35 per cent. of combustible gases. If we could eliminate the nitrogen from the atmosphere by a cheap and simple process, and supply oxygen alone and in the requisite quantity to convert all of the carbon into carbonic oxide, we should get from a ton (2240 lbs.) of anthracite 4666 lbs., or nearly 60,000 cubic feet of this gas, containing 20,200,000 heat-units. The coal itself would possess almost one-third more heat-units than this—*i.e.*, 29,000,000, if we allow 240 lbs. of the ton as ash Apparently there is here a decided loss in converting coal into gas. The loss is, of course, due to the partial combustion which takes place when one atom of oxygen unites with one of carbon —carbonic oxide being the product. In other words, if we convert the carbon at once to its final product—carbonic acid—from 1 lb. of carbon so consumed 14,500 heat-units are evolved; whereas, if we turn the carbon first into carbonic oxide, we evolve from the same quantity of carbon 4400 units, obtaining

233 lbs. of carbonic oxide. This, when it is burned, evolves only 10,092 heat-units; so that the 4400 units appear to be lost.

What becomes of the heat we call lost? It is generated in the furnace; and while some of it is radiated through the sides, most of it is carried off by the gas, which leaves the furnace at a high temperature. If, therefore, we use the gas in its heated condition as it is generated, we shall lose, approximately, only that quantity lost in the furnace itself. We should obtain the 20 million heat-units from the actual combustion of gas, and probably 7 million units more of sensible heat. Now, the effect of the nitrogen—the presence of which we cannot avoid, if we use air—is not to lessen the total quantity of the carbonic oxide producible, but to lower the temperature of the furnace. The weight and volume of gaseous products being greatly increased, the heat is spent over a larger volume, and the temperature is necessarily reduced. Of course, a given volume is less combustible than when the nitrogen is absent. In this case we obtain 170,000 cubic feet of gaseous products, 110,000 cubic feet of which is inert nitrogen. What would be the temperatures of the furnace where the nitrogen is present and where it is absent? In the one case, the furnace heat would be—

$$\frac{2000 \times 4400}{4666 \times 0{\cdot}2479} = 7600^{\circ} \text{ Fahr.}$$

In the other—

$$\frac{2000 \times 4400}{(4666 \times 0{\cdot}2479) + (8664 \times 0{\cdot}244)} = 2685^{\circ} \text{ Fahr.}$$

By furnace heat we mean the average temperature existing in the furnace. In practice, we have really a gradually descending degree of temperature from the zone of combustion to the zone of distillation—where the gases leave the furnace. The zone of combustion exists where the air is supplied to the fuel. In this region active combustion ensues; and the carbon is converted into carbonic acid gas *per saltum*. In passing through the superincumbent coal, the carbonic acid gas gives off part of its sensible heat to the coal, and at the same time undergoes a transformation by losing an atom of oxygen, which unites with the free carbon, and is thus converted into carbonic oxide (expressed by the equation $CO_2 + C = 2CO$). That portion of the furnace in which the chemical transformation occurs, we term the "zone of carbonization." This change entails a further loss of heat. In passing out at the top of the furnace, the gas imparts a further quantity of sensible heat to the top layers of fresh unconsumed coal, and carries off the moisture in the form of steam. There is, therefore, a gradually diminishing furnace heat from the zone of combustion—say, 2500° to 3000° Fahr. down to probably from 1000° to 1500° Fahr. at the take-off pipe.

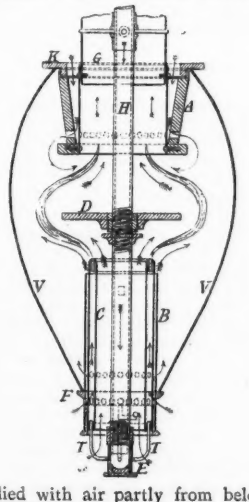
Now, if the gas has to be stored for any length of time, or conveyed long distances through cold pipes, a very severe loss is necessarily entailed. For instance, in burning the gas produced from a ton of coal, at atmospheric temperature, we should lose an amount of heat equal to from 4 million to 7 million heat-units. This would prove a serious loss; and, in order to avail ourselves of a portion of this thermic capital, we must burn the gas as it issues from the furnace, without permitting it to cool. As most of you are aware, the feature of the Siemens regenerative furnace consists in the utilization of this sensible heat.

(*To be continued.*)

REGISTER OF PATENTS.

Regenerative Gas-Lamps.—Greene, T. A., and Walker, C. M., of Cannon Street, London. No. 18,618; Nov. 18, 1890. [6d.]

This invention relates to a gas-lamp having an Argand flame spread out below by a deflector, and contracted above towards a central



chimney, and supplied with air partly from below heated by conduction from the burner, and partly from above heated by conduction from the chimney; the burner and air passages all being enclosed within an elongated bulbous glass.

In this illustration, H is the gas-supply pipe, the lower end of which is closed by a screw cap or plug E, removable to clear out matter deposited from the gas. Gas passes by several branches T to an elongated Argand burner C, surrounded by a concentric jacket B, so that there is a narrow annular air passage between the jacket and the burner tube. On the jacket (which is held on the burner tube by a bayonet catch) there is a flange F, supporting the glass V. Below the flange perforations through the jacket-tube allow air to enter—some of it passing by perforations above the flange into the space enclosed by the glass, but most of it ascending between the jacket and the burner, and so becoming heated and issuing under the flame, which is spread outwards by a deflector D, and above the deflector turns inwards to the mouth of the chimney G. This chimney, which is carried on the gas-pipe, has its lower end surrounded by a concentric casing A, the lower part of which is perforated with numerous holes. Above the casing is a loose flanged ring K, resting on the upper edge of the glass V, which is of an elongated bulbous form, enclosing the whole of the lamp, except the upper part of the chimney and the lower part of the burner. The lamp is lighted from below, inside the burner; the flame being supplied with heated air, partly below from the jacket B, and partly above from the annular passage between the chimney and the casing.

Distilling Tar.—Lennard, F., of East Greenwich. No. 844; Jan. 16, 1891. [1s. 1d.]

The object of this invention is to provide means by which tar distillation can be carried on "expeditiously, and so as to obtain in a manner readily under control, the various products of distillation; the heat of the vapours of distillation being used to effect the partial heating of the matter to be distilled, which assists the condensation of the vapours."

The tar to be distilled passes, or is forced, from the store-tank into vessels in which the ammoniacal liquor separates, owing to the heated condition of the tar. This heating is effected by forcing it (on its way to these vessels) through one or more condensers, so that the tar acts as the cooling medium for condensing the tar vapours therein. The tar is then passed or forced through heated coils of pipes or like extended passages; the heat being applied to the coils or passages in any suitable way—for instance, by the coils or the like, or some of them, being situated in an oven or sand bath. The tar flowing through these coils thus becomes heated to, or above, the point at which its vaporizable constituents required to be extracted would become vaporized if not confined therein. It then passes into a scrubber, on admission to which its vaporizable constituents vaporize; it being therein subjected to the action of steam or other disassociating agent—the pitch depositing in the scrubber, while the vapours pass therefrom into condensers, in which the various products deposit separately.

One arrangement of apparatus consists of a furnace with return flues, preferably heated with liquid or gaseous fuel, and above it an oven or sand bath, in which are coils communicating with other coils situated in a chamber through which the products of combustion pass, and which the patentee calls the "economizer." There is also a scrubber, consisting preferably of a vertical tower, having a series of tubular passages so arranged that the tar will pass downwards therethrough in a circuitous manner, meeting a current of steam or other disassociating agent in its descent, which carries off the desired products from the tar; the pitch which is thus formed depositing at the bottom of this tower. There are also condensers into which the vaporized products pass, and in which the several products deposit separately. These condensers preferably consist of vertical vessels provided with tubes, and with outlets and inlets arranged so that the vapours pass inside the tubes, while the cooling and condensing agent passes on the outside.

In the first condenser of the series, the condensing agent is the tar from the ammoniacal liquor separators; while in the others, it may be the coal tar which is ultimately to be distilled. The tar to be distilled may be pumped through (say) the last of the condensers, and passes around the tubes thereof and thence either direct by a pipe to the tanks or vessels in which the ammoniacal liquor separates from the tar and is retained; or before passing to these tanks or vessels, it may be sent through another of the condensers, and around the tubes thereof. The tar is forced from these tanks or vessels, by a pump, into the first of the condensers; then through the coils in the economizer; and thence through the coils in the oven or bath. Thus the tar is heated to the degree requisite to cause the vaporizable constituents to vaporize. The tar then issues therefrom and passes into the scrubber, where it meets a current of steam, or other disassociating agent, by which the vapours are driven to the first condenser, wherein the heaviest products (the anthracene oils) deposit, while the pitch deposits at the bottom of the scrubber. The uncondensed vapours pass from the first into the second condenser, in which the next products (creosote oils) deposit; the vapours which are still uncondensed passing into the last of the condensers, wherein the lightest products (naphtha and light oils) are condensed.

The coils of the economizer and oven or bath are preferably flattened; and to provide extended heating surfaces, they have fins on them. Also, to conduct heat to them, there are pipes or passages of refractory material extending from the furnace or flues (or both) to between the convolutions of the coils. By regulating the speed at which the tar is passed through the apparatus, the proper degree of heat for distilling is obtained, irrespective of the temperature above that required for distilling tar, at which the furnace and the oven or bath may be maintained.

Gas Motor Engines.—Abel, C. D.; communicated from the Gas Motoren Fabrik Deutz, of Coeln-Deutz, Germany. No. 1903; Feb. 2, 1891. [8d.]

This invention relates to valve apparatus for controlling the admission of gas and air to the working cylinder of gas motor engines; and it consists in an arrangement whereby the simultaneous opening and closing of valves controlling respectively the gas and the air supply is effected, in order to insure the formation of a uniform explosive mixture during the whole of the suction stroke.

For this purpose, an annular gas passage in the casing of the gas and air mixing-valve communicates by a passage (provided with a shut-off cock, valve, or slide) with a space on the underside of the gas-admission valve, the chamber above which communicates with the gas-supply pipe. The stem of the gas-valve passes down through a partition into a lower chamber; and it there carries a second valve that closes the air-supply inlet—such chamber being also made to communicate by a passage with the chamber below the mixing-valve. The gas and air valves are so proportioned that, on the production of a partial vacuum beneath the former and above the latter, the upward pressure of the outer air tending to open the air-valve will overbalance the downward pressure of the gas supply on the gas-valve, so that the two valves will be simultaneously opened to an extent dependent on the differential pressure produced. The annular gas passage of the mixing-valve is provided with a series of small horizontal holes communicating with the chamber below the valve.

The action of the arrangement is as follows: On the engine piston commencing its suction stroke, the gas and air mixing-valve will be first opened by the suction produced; and an exhaust being then produced above the air-admission valve and below the gas-valve, these will be made to open (as described), so as to cause gas and air of the desired proportions to enter the chamber of the mixing-valve, and to pass thence into the cylinder—the gas being made to issue in a number of small jets transversely through the air current, so as to become effectually mixed therewith, in order to produce a uniform explosive mixture. On the engine running too fast, the cock, valve, or slide in the gas passage is closed by the action of the governor, by means of any well-known arrangement; and hereupon, although both the gas and the air valves will be opened on the suction stroke as described, only air will enter the cylinder until, on the reduction of the speed, the gas passage is again opened.

Manufacture and Distribution of Gaseous Fuel.—Ormiston, J. W A. R., and J., all of Glasgow. No. 1909; Feb. 3, 1891. [8d.]

In carrying out this invention, ordinary coal is employed to make the gaseous fuel; such coal being put into a large cupola or chamber like that of a blast-furnace, and provided with apparatus for injecting a strong blast of air in one or more streams at its lower part, also with apparatus at its upper part for leading away the volatilized products to condensers, scrubbers, and other apparatus for separating and recovering their various constituents. The upper part of the cupola is also provided with appliances of well-known kinds for charging in coal or carbonaceous materials as required; while at the lower part arrangements are made for withdrawing unvolatilized residues. These unvolatilized residues or ashes of ordinary coal are, by themselves, troublesome to deal with; but by this invention, say the patentees, when ordinary coal is used, suitable earthy materials are mingled therewith—these materials being such as will, with the earthy ingredients of the coal itself, form a fluid slag, which can be tapped at the bottom of the cupola, and be thus withdrawn with great facility and with little labour.

Instead of ordinary coal forming the only carbonaceous part of the charge, there may be mixed therewith, or used instead thereof, any carbonaceous minerals of the kinds comprising comparatively large proportions of earths—such, for example, as the poor shales known as "blaes," and not considered profitably workable for the obtainment of paraffin oil. In case the earths of such minerals are found to be by themselves not well adapted for forming a fluid slag, other suitable earthy matters may be added to combine with them to form a flux. The addition of earthy matters for fluxing purposes will also prevent fusing and caking together of coaly constituents having this tendency in the upper part of the cupola. Among the materials to be added for fluxing purposes, mention is made of ordinary blast-furnace slag; also of limestone or other carbonate, the carbonic acid from which contributes to the formation of the gaseous fuel, while its use somewhat diminishes the percentage of nitrogen in the total products.

In operation, an intense heat is maintained at the lower part of the cupola, by means of the blast, so as at that part to drive off the remainder of the volatile matters, and fuse the earthy residues. The highly-heated gases evolved at the lower part will, in rising, operate on the materials above; the heat of the gases being utilized in gradually volatilizing the carbonaceous matters. Any carbonic acid formed at the lower part will be converted to carbonic oxide a little higher up; and the gaseous products passing off from the top of the cupola will consist largely of carbonic oxide, which is one of the principal ingredients of the gaseous fuel intended to be manufactured, but which will have associated with it hydrocarbons and other matters. Excepting the nitrogen of the air forming the blast, and permanent gases containing carbon and hydrogen, the volatilized matters associated with the carbonic oxide will be separated and recovered by any well-known means, and will form saleable products, the value of which will reduce the cost of the gaseous fuel.

In large works—such as those for making steel, where quantities of fuel have to be consumed—special or separate installations for making the gaseous fuel may, the patentees remark, be provided; but in the case of a large number of works in each of which only moderate or small quantities of fuel are used, it will be advantageous and economical to provide in a district a large central installation, from which the gaseous fuel can be distributed to consumers through pipes or other channels. It is moreover contemplated, by the present invention, to supply the gaseous fuel even to dwelling-houses, and to any structures using fires, however small. As the distribution of the gaseous fuel in the general way indicated will necessitate means for conveying very large volumes, it is proposed, while using iron or steel pipes where only moderate sizes are required, to form underground tunnels, to serve as the larger channels required. Such channels would be constructed of, or lined with, brickwork or concrete where necessary; and where such tunnels would have to be at some depth below the surface, vertical shafts or wells would be formed in connection with them at suitable points, from which smaller distributing-pipes would radiate.

Advantages of some importance would arise from the use of "blaes," or poor shales in the manner indicated, as it has been ascertained that the carbonaceous constituents of such shales (although associated with a large proportion of earthy matters) are of a nature to yield, when volatilized, both condensable and permanently-gaseous products, which are considerably richer in hydrocarbons than ordinary producer gas; so that a given volume of the gases produced from the "blaes" will contain more combustible matter, and yield more heat, than an equal volume of producer gas.

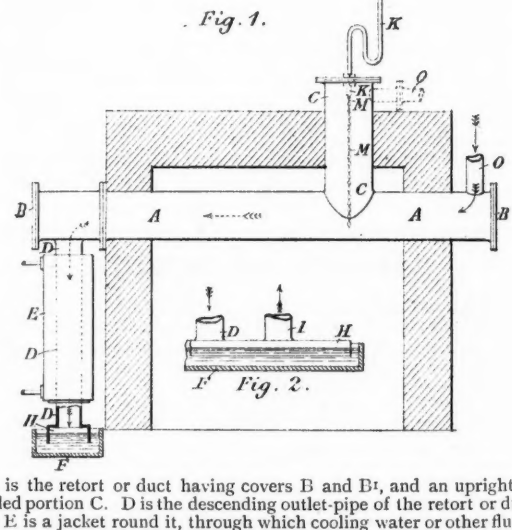
Manufacture of Illuminating and Heating Gases.—Dinsmore, J. H. R., of Liverpool. No. 2948; Feb. 18, 1891. [8d.]

This invention, says the patentee, has "mainly reference to those processes of making illuminating or heating gas in which tar or other hydrocarbon liquid is employed and converted into gas in conjunction with coal or other carbonaceous material; and it has for its object, and consists of, certain arrangements and dispositions of parts and modes of carrying out such processes."

According to this invention, there is employed one or a plurality of retorts or chambers set in a suitable heating chamber or bench, and adapted to be externally heated by coal or coke fires, or by gaseous fuel. These retorts are provided with a door in front of the bench, or with a door both at the back and front; and they are so arranged, and the bench so built and adapted, that access to the inside of the retorts can be readily had, and their interiors operated upon from the ground level. Tar is passed into the retorts at any convenient point; and, in conjunction therewith, gas (say, ordinary illuminating gas) is also introduced—the result being that the gas combines with the tar gas resulting from the distillation of the tar by the heat of the retort, and a combined gas of a high illuminating power and great volume is produced. This combined gas leaves the retorts in a downward direction—that is, it is carried from the chamber or retort exit downwards—and directly upon leaving the retort, it is artificially cooled. This is preferably done by passing it through an externally cooled (say, a water jacketted) conduit, which opens out at the bottom into a chamber sealed in water, tar, or other suitable liquid, wherein any grosser particles of tar, or unfixed tarry vapours or carbon are arrested. From this chamber the gas is led away to be cooled or condensed in any ordinary suitable apparatus, and then stored or used.

In an ordinary illuminating gas-works, the patentee remarks, the whole of the gas produced may be treated as described, or only a portion may be so treated, and such portion mixed with the bulk. And, in lieu of illuminating gas, water gas, hydrogen, or other suitable gas may be heated in conjunction with tar as explained, and its illuminating power and volume increased. The hydrocarbon liquid—*i.e.*, tar, or other hydrocarbon or mixture thereof—may be introduced into the retorts in a soild form—say, from above, allowing it to fall on to the bottom thereof. Or it may be supplied by spraying or atomizing devices.

In the accompanying illustration, there is shown the apparatus for distilling tar in the presence of coal gas (or other gas), consisting of a duct or retort, and having covers at each end. Although only one duct is shown, "any suitable number may be disposed within the bench in any convenient manner, and heated by a furnace in any known suitable way."



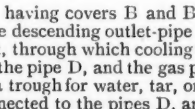


Fig. 2.

A is the retort or duct having covers B and B1, and an upright extended portion C. D is the descending outlet-pipe of the retort or duct; and E is a jacket round it, through which cooling water or other fluid is circulated, and by which the pipe D, and the gas passing through it, are artificially cooled. F is a trough for water, tar, or other liquor; and H is an inverted trough connected to the pipes D, and by which a seal is made between these pipes and the outside atmosphere. I is an ascension or outlet conduit, by which the gases are conveyed away from H to the place required. K is a syphon tar-supply device; and M represents a length of chain, or the like, connected to the delivery end of the pipe K within the retort or duct portion C, and by which the tar is led to near the bottom of the duct A before it falls on to it. O is a pipe by which coal or other suitable gas is introduced into A.

The operation of this apparatus, according to one mode, is as follows: Coal gas—say, previously mainly ridded of water or condensable watery matters, or containing such watery matters, is introduced into the duct or retort A by the pipe O; and, in conjunction with this gas, tar is introduced, in regulated quantities, by the device K into the duct or retort. As the tar falls on to the bottom of the duct, it is vaporized, the vapour becoming mixed with the coal gas. In the passage of the tar vapours through the duct, in combination with the coal gas, they are more or less converted into permanent gas by the heat of the duct. The tar and coal gases, in their mixed condition, are then conveyed downwards through the pipe D; and, in their descent, they are artificially cooled by the cooling fluid passing round the pipe D. By this cooling effect, the pitchy and some of the tarry

vapours or matters in the gases are arrested, and fall toward the cooler part of the pipe and into the trough F. By this mode of ridding the gases of objectionable matters, all liability of the outlet-pipe of the ducts becoming choked, is obviated. The pitchy and tarry matters as they condense, or are arrested in D, fall by gravity into the liquid in the trough F; and thus solidification and incrustation in the pipe D is prevented.

In addition to the liquid seal, a cock or valve on the pipes D may be employed to shut off a retort or duct A, when required. Or a cock or valve only may be used; the pipes D in such a case delivering the gas into a suitable main.

In some cases, in lieu of introducing coal gas through the pipe O, the gas may be distilled from coal charged into the retorts (say) through the charging-mouth door B. Or again, coal gas may be introduced from the pipe O in conjunction with its manufacture from coal in the retort. Or, as a further modification, hydrogen, water gas, producer gas, or other gases, may be introduced into the retort alone or with other gases, and carburetted, or its illuminating power increased, by its mixture with tar gases generated as described.

In lieu of tar being used, other hydrocarbon oil may be employed for the purpose of raising the illuminating power and increasing the volume of gases of the nature described in operating according to this invention.

APPLICATIONS FOR LETTERS PATENT.

15.—CAMPBELL, H., "Gas motor engines." Jan. 1.

24.—WILLIAMS, H., "Gas-purifying apparatus." Jan. 1.

55.—POTTER, W. G., "Gas and petroleum and hot-air engines for propelling tramcars, bicycles, torpedo, and other boats." Jan. 2.

112.—RICHARDSON, J., and NORRIS, W., "Gas and vapour engines." Jan. 4.

247.—NICHOLSON, T. and E. T., "Heating gas and air, and supplying the same to boiler and other furnaces and fire-places." Jan. 6.

260.—EDWARDS, E., "Carburetting air or forming explosive mixtures for gas-engines." A communication from G. Petit and E. Blanc. Jan. 6.

261.—SPRATT, C., "Gas-valve and regulator." Jan. 6.

465.—THORP, T., MARSH, T. G., and HAYNES, J., "Prepayment mechanism of gas-meters." Jan. 9.

482.—MARTIN, J. C., "Manufacture of coal gas." Jan. 9.

European Gas Company.—The Directors of this Company have declared interim dividends of 8s. each on the £10 shares, and 6s. each on the £7 10s. shares.

Shocking Death of a Gas Stoker at Blackpool.—Whilst attending to a fire at the Blackpool Corporation Gas-Works recently, a stoker, named Richard Brady, allowed the whole of the fire to drop into a trough below; and the steam and water scalded him to such an extent that he died on Sunday night of last week.

New Joint-Stock Companies.—A limited liability Company has been formed to take over the businesses of Messrs. Oates and Green and of the Ellen Royde Brick and Fire-Clay Company, both of Halifax, and old-established and well-known firms in the fire-clay trade. The business will be conducted under the style of Oates and Green, Limited. No shares will be issued to the public; the whole of them having been taken up by the members of the old firms. The Electric Fittings Hiring and Maintenance Company, Limited, has been registered with a capital of £200,500, in 40,000 ordinary, and 500 founders' shares of £5 and £1 each respectively, to establish and maintain cables, wires, lines, accumulators, lamps, works, and fittings of every description for the generation, distribution, supply, accumulation, and employment of electricity; to carry on business as electricians, generators and suppliers of electricity, mechanical engineers, manufacturers of, and dealers in all kinds of apparatus therefor; and to effect insurances against fire or accidents arising from the employment of electricity. The Metropolitan Light Company, Limited, has been formed with a capital of £5000, in £1 shares, to acquire the undertaking of D. C. Defries, now carried on at Nos. 43 and 44, Holborn Viaduct, under the style of the Metropolitan Light Company, in accordance with an agreement made between D. C. Defries of the one part and the Company of the other part, and generally to carry on business as gas, electrical, and general engineers.

The Staffordshire Gas and Coke Company.—In the Chancery Division of the High Court of Justice last Wednesday, before Mr. Justice Kekewich, Mr. Dunham, in an adjourned summons relating to the above matter, applied to vary the Chief Clerk's certificate by removing the names of Mr. T. Nicholson and others from the list of contributories to the Company; the names having been placed thereon by the Chief Clerk at the instance of the Liquidator, whom Mr. Renshaw, Q.C., now represented. The learned Counsel, in support of the summons to vary, said the applicants had been placed on the list of contributories for shares of £5 each under the following circumstances: Mr. Nicholson was the owner of two patents for making coal gas, and he formed a Company, called the Mercantile and Domestic Company, consisting of himself and his relatives, to purchase the patents. By an agreement between the Mercantile and Domestic Company—Mr. Nicholson and Mr. Burrows acting on behalf of the Staffordshire Gas and Coke Company—the exclusive right of licences in respect of those two patents was granted in consideration of a sum of £60,000, to be paid in fully paid-up shares of the intended Company, or cash, at the option of the purchaser, Mr. Burrows. By virtue of this agreement, a certain number of shares were allotted to Mr. Nicholson; but, it being discovered that there was no registration under the Act of Parliament, a re-allotment took place, and the Liquidator claimed in respect of this to have the applicants placed in the list of contributories as the holders of unpaid shares. Mr. Dunham contended, on behalf of the applicants, that, inasmuch as a mistake had been made, the Company were justified in making the necessary correction by cancelling the first allotment. Mr. Renshaw, on behalf of the Liquidator, opposed the summons. He submitted that the Chief Clerk was right in what he had done; and argued that Mr. Nicholson and the others were privy to it all. Mr. Justice Kekewich, in the result, held that the Chief Clerk had acted rightly; and he disallowed the summons.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by correspondents.*]

Standards of Light.

SIR,—After the invitation in your recent leader for expressions of opinion from your readers on this question, I am disappointed that such an important subject has not provoked a better and more varied discussion. With a view of, if possible, inviting others to publish their opinions, I may give a brief epitome of my own views on the matter, more especially as I have recently devoted considerable time to testing the most improved forms of modern standards and apparatus.

In the first place, I wish to emphasize the fact that, whatever form of standard of light or of apparatus employed is proposed to replace the present candle standard and the present apparatus, it will be a distinct advance to introduce a system of gas testing which will be thoroughly reliable, which is not too technical, and which can consequently be relied upon to give practically identical results in the hands of competent men. In my opinion, such a system is already in existence; but the main difficulty to its adoption will be the fixing of the exact equivalent of the old and the new methods. To make my meaning more clear, it cannot be ignored that gas companies, at the time their respective Acts of Parliament were passed, accepted certain conditions as to the price of the material which they were to supply, and the conditions under which it was to be valued. It was subsequently found by the companies that these conditions could be conformed to by certain definite expenses of manufacture; and, on this basis, reductions in the price of gas were made, with increased profit to both shareholders and consumers. In the meantime, the Referees were making radical changes in the construction of the photometers employed in official testing; and the general concensus of opinion among the companies where gas is now tested by the scientifically improved forms of instrument is that, under the same manufacturing conditions as prevailed of old, a lower value is attributed to their gas The consequence of this is that the companies claim they have increased cost of manufacture to comply with their statutory obligations. In proposing a new standard of light, this claim should certainly receive impartial investigation, and (as I stated in a previous letter) the equivalent in standard candles of any substitute must be fixed in terms of standard candles as employed at the time the respective companies accepted their present parliamentary obligations.

I now turn to the subject of the lines upon which the photometry of the future may be conducted. Initially, I think that everyone recognizes candles as an unsatisfactory standard; and that, if gas companies have not sufficiently endorsed this, it is due to a mistrust in the powers that be, and a general feeling of a Shakesperian character with regard to "rather bearing the ills they have, than fly to others which they know not of." Admitting this much, and that the equivalent of any standard for candles would be fairly and equitably decided; admitting also that if this were done, any system of photometry would be welcome that would be the most reliable, I should wish to make the following recommendations:—

(1) That the future standard should be the pentane Argand as proposed by Mr. Dibdin, but so constructed as to afford a light of 16 candles in place of 10 candles as at present made.
(2) That the form of photometer be an open table instrument, such as advocated by Mr. Vernon Harcourt.
(3) That the temperature of the room be maintained practically at 60° by a thermostat, and that its *minimum* size and conditions of ventilation be (as nearly as possible) defined.
(4) That considering the effects of water vapour (as shown by Mr. Methven's experiments), and also of varying barometrical conditions on the luminosity of flames, some correction other than that in use should be employed.
(5) That the rigid adherence to a 5-foot consumption should be abandoned; and the gas burned to a constant 16-candle flame, as advocated by Mr. Vernon Harcourt.

I should have been glad to have amplified this better, in giving my reasons for the above recommendations; but I must defer this to your next issue.

Jan. 16, 1892. H. LEICESTER GREVILLE, F.I.C., Etc.

The Effect of Air on the Illuminating Power of Gas.

SIR,—In view of the confident assertions made by the author and some speakers on the paper on "Purification" read at the meeting of the Incorporated Institution of Gas Engineers in May last, do not Dr. Schilling's experiments, recorded in the "Note" in your last issue (p. 65) call for some notice from those gentlemen and others who have from time to time expressed a contrary opinion? Dr. Schilling is a careful experimenter—one of the most careful in Europe—and is not likely to put on record the result of experiments that can be disputed.

To be perfectly open in this matter, I may say that I have a reason in writing—viz., that experiments of my own, carefully repeated many times, and again re-tried after reading the paper referred to, bear out, within a point or so, the report of Dr. Schilling. Moreover, I find no difference in my results if I admit a known percentage of air into a test holder, mixing it direct with the purified gas, or if the same known percentage is admitted at any part of the apparatus used in manufacture, either before or after purification, no matter whether the purifying material is lime or oxide. This latter result was not to be expected, seeing that one-fifth of the air should be taken up in passing either the lime or the oxide. Nevertheless, it is so; and I must honestly confess that, in my case, the use of air reduces the illuminating power to the extent shown in Dr. Schilling's paper.

London, Jan. 14, 1892. A PUZZLED INQUIRER.

Proposed Reduction in the Price of Gas at Doncaster.—At a meeting of the Gas Committee of the Doncaster Corporation last Thursday, it was decided to recommend the Council to reduce the price of gas from 2s. 11d. to 2s. 6d. per 1000 cubic feet, and to give discount to all customers to the extent of £1 per annum.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Monday, Jan. 11.

(*Before Mr. Justice* CHITTY.)

Andrew and Co. v. Crossley and Co.—Crossley and Co. v. Andrew and Co.

These actions raised important questions as to the procedure under the Patents Acts. Messrs. Crossley Bros., Limited, were the owners of a patent granted in 1881 for improvements in gas motor engines, &c.,; and an action having been brought and a motion made by Messrs. J. E. H. Andrew and Co. for an injunction to restrain Messrs. Crossley Bros. from alleging that Messrs. Andrew and Co. had infringed their patent, and from making threats of taking proceedings in reference to such alleged infringements, the motion stood over on an undertaking given by Messrs. Crossley Bros., embodied in an order of March 28, 1890, to bring an action against Messrs. Andrew and Co. for an infringement so soon as a disclaimer by Messrs. Crossley Bros. of certain claims in the specification of their patent should be allowed. At the date of the undertaking, Messrs. Crossley Bros. had, in pursuance of the provisions in section 18 of the Patents Act, 1883, applied for leave to amend their specification. Notice of opposition was given by Messrs. Andrew and Co., who, on May 19, 1890, appeared before the Comptroller and opposed. On June 9, 1890, the Comptroller gave his decision, allowing the amendment with a certain modification, and subject to the condition that Messrs. Crossley Bros. should not sue for infringements committed before Jan. 1, 1884—that was to say, the day on which the Patents Act of 1883 came into force; being a condition which is invariably imposed in such amendment proceedings when the patent was granted before that date. On June 11, 1890, Messrs. Crossley Bros. issued their writ commencing the infringement action against Messrs. Andrew and Co. On June 30 a notice was sent to Messrs. Crossley Bros. from the Patent Office, requesting them to furnish "the undertaking required" by the Comptroller that they would not take legal proceedings in respect of infringements antecedent to Jan. 1, 1884. On July 9, 1890, Messrs. Crossley Bros. gave the undertaking. On Aug. 25 the specification was formally amended; and on the following day, the amendment was duly advertised under the Act. The two actions having been referred by consent to a learned Arbitrator, and it having been proposed on behalf of Messrs. Crossley Bros., when opening their action before the Arbitrator, to put in the amended specification, objection was taken on behalf of Messrs. Andrew and Co. as to its admissibility in evidence, on the ground that on June 11, 1890, being the date of the issue of the writ, the amendment had not been actually made, and that, by the 10th sub-section of section 18 of the Act of 1883, it was provided that the procedure, under the foregoing provisions of section 18, should not apply when and so long as any action for infringement or other legal proceeding in relation to a patent was pending. The Arbitrator delivered a written decision on the point raised, in which he held that the amended specification could not be admitted; holding that the amendment must be treated as dated July 9, when Messrs. Crossley Bros. gave the undertaking, and therefore as subsequent to the date of the writ in the action, and that the undertaking was a material and necessary step for the completion of the disclaimer. This decision of the Arbitrator was now reviewed by the Court; and it was not upheld.

The ATTORNEY-GENERAL (Sir R. E. Webster, Q.C., M.P.) and Mr. W. N. LAWSON appeared for Messrs. Crossley and Co.; Mr. HOPKINSON and Mr. J. C. GRAHAM, for Messrs. Andrew and Co.

Justice CHITTY, in delivering judgment, said that, although no authority for the Comptroller to impose conditions was mentioned in sub-section 3 of section 18, which related to opposed applications, it was clear that he had such authority. The Comptroller, however, in the present case had not, in fact, required an undertaking to be given. All that was needed was that Messrs. Crossley Bros. should give their assent in writing to the condition imposed by the Comptroller's decision. The Arbitrator had decided that the leave to amend was not complete until the undertaking was given on July 9. It followed from this view that, by reason of the issue of the writ on June 11, the proceedings before the Comptroller were stayed by virtue of sub-section 10. Before him (Justice Chitty) it had been contended that this was the right view, and also that any writ issued before Aug. 26—the date when the amendments were actually made—would necessarily stay any further proceedings before the Comptroller. In other words, it was argued that Messrs. Crossley Bros. were not entitled to commence any action on the amended specification until after Aug. 26. The decision of the Arbitrator and this further contention, which went beyond his decision, were grounded on sub-section 10 of section 18, and went, if sound, to upset all that had been done in the Patent Office after June 11, because on and after that date an action for infringement was pending. Accordingly, with all that, Messrs. Crossley Bros. must have dismissed their action for infringement, and have proceeded *de novo*, before they could bring another action for infringement. But, in his opinion, neither of the contentions on behalf of Messrs. Andrew and Co. could be maintained. The correct reading of section 18 was that the proceedings for amendment terminated with the leave to amend. No further provision was made. True it was that the actual amendment was made by virtue of section 18, and of that section only; but there was no direct provision for making the amendment. It was treated as something which followed from the Comptroller's decision, and something to be done as a mere ministerial act, and as a matter of course in pursuance of the decision. Sub-section 9 enacted that leave to amend should be conclusive as to the right of the party to make the amendment, except in the case of fraud; and then, tacitly treating the amendment as in fact made, and without any provision as to the amendment being made, it went on at once to enact that the amendment should, in all Courts and for all purposes, be deemed to form part of the specification. Obviously, the Legislature thought it superfluous to insert any provision as to the making of the amendment. Further authority was given to the Comptroller and to the Law Officer, when there was an appeal, to impose conditions; but no provision was made for the acceptance of any condition imposed. No doubt the patentee could, if he were dissatisfied with the conditions imposed, decline to allow his specification to be amended; and he might, by notice to the Patent Office, require that no amendment should be made. No doubt it was also a convenient and reasonable course on the part of the office to obtain an assent in writing from the patentee before making the actual amendment. The written assent precluded the patentee from alleging that he did not accept the conditions. It was an error, however, to ask for an undertaking. The undertaking given in this case added nothing to the force of the condition imposed by the Comptroller under his statutory authority. No action or proceeding of any kind could be taken to enforce the undertaking, which was given to the Comptroller alone. It also appeared that the Comptroller did not insist upon any particular form of undertaking or consent; but all that was required was an assent before proceeding to make the amendments. In this case, the assent was given on behalf of Messrs. Crossley Bros. at the hearing before the Comptroller on May 19, although it was not stated in the Comptroller's written decision of June 9 that they had accepted the condition. He (Justice Chitty) thought that a subsequent written assent to the condition was not necessary, although, as a mere matter of business, and to preclude any possible question, it was not unreasonable to ask for an assent in writing. In any case, he held that a written assent to a condition imposed by the statutory authority related back to the Comptroller's decision. He held—and that appeared to him to be the one crucial point of the case—that the giving of the assent did not fall within the meaning of the words, "the foregoing provisions of this section," contained in the 10th sub-section of section 18, and consequently that it was not a step the taking of which was prohibited while an action for infringement was pending. For these reasons, he held that the amended specification was admissible. The practice of the Patent Office was to state at the top of the printed copies of amended specifications as the date of the amendment the date of the decision giving leave to amend. He held that such practice was correct, and in conformity with the Act of Parliament.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Wednesday, Jan. 13.

(*Before Justices* LAWRANCE *and* WRIGHT.)

Page v. Kettering Water-Works Company.

This was a special case submitted for the opinion of the Court under the following circumstances: The plaintiffs are owners of mills on the River Ise, below Kettering; and they claimed compensation from the defendant Company in respect of the injury sustained owing to the latter impounding the water of two brooks above the town, which formerly united in another stream which ran into the Ise before it reached the plaintiffs. The matter had been submitted to arbitration; and the Arbitrators had found that, if the Company were to compensate the claimants for all the water intercepted, the amount should be £825. But, as circumstances stand at present, the bulk of the water, after being employed for domestic and other uses by the inhabitants, and by the Local Board of Kettering for sewerage purposes, is returned into the stream, and ultimately reaches the Ise as before; and if this ought to be taken into account, the amount of compensation should be £55 only.

Mr. LUMLEY SMITH, Q.C., and Mr. RIGG appeared for the claimants; Mr. MEADOWS WHITE, Q.C., and Mr. COWARD for the Company.

Mr. LUMLEY SMITH contended that the Company must be taken to be purchasers of the water they impounded from the two brooks, and that, when they sold it in retail or bulk, they had no further control over it; and the Local Board might, by a change of sewerage system, at any time prevent the return of the water to the Ise. There was no certainty, therefore, that the present state of circumstances would continue; and the claimants were entitled to the higher amount of compensation.

Mr. MEADOWS WHITE, on the other hand, argued that it was a case of "injuriously affecting," and not of purchase. The claimants were, he said, only injuriously affected to the amount of £55. They were not the owners of the two brooks which were intercepted, and therefore were only entitled to the smaller amount.

Justice LAWRANCE, in giving judgment, said in his opinion the case ought to be remitted to the Arbitrators, because it was somewhat doubtful in his mind on what principle they had found the sum of £55. If they had looked at all the circumstances which might arise hereafter—including the question whether the flow of water which at present ran into the Ise was likely to continue, taking into account what might happen if Kettering were to increase to a large extent, and whether more water would be required if another system of drainage were adopted—then no further consideration would be necessary. But with regard to the amount of £55, he thought it would be more satisfactory that the matter should go back. The main question was what was the compensation to which the mill-owners were entitled? Were they entitled, under the Water-Works Clauses Act, as for a purchase? Or were they entitled only to compensation for being injuriously affected, under the Lands Clauses Consolidation Act? The case did not seem to come within *Stone v. The Corporation of Yeovil*, but was more like *Bush v. The Trowbridge Water Company*. There the plaintiff was the owner of a stream, and the Company put in a pipe higher up the stream, and diverted a portion; and the plaintiff sought to make the Company purchase the whole stream. It was pointed out there that the plaintiff had no right to anything of the kind. What she was entitled to was compensation for being injuriously affected. Here a small part of the water of the River Ise was being taken away; and the Water Company could not be compelled to pay the whole value in the same way as if they were forced to purchase the two brooks. The true principle on which the compensation should be based was that the Arbitrators should look at the probabilities of the case; taking all the facts into consideration as though they were valuing a piece of ground likely, within reasonable time, to be turned into building land. The judgment must, therefore, be for the respondents.

Justice WRIGHT gave judgment to the same effect.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Friday, Jan. 15.

(*Before Mr. Justice* DENMAN *and a Special Jury.*)

Higgins v. Ward.

Slander by the Assistant-Secretary of the Gas-Workers' Union.

To-day an action brought by John William Higgins, a gas stoker, formerly of Salford, but now in the service of the South Metropolitan Gas Company, against William H. Ward, Assistant-Secretary of the Gas-Workers' and General Labourers' Union, to recover damages for an alleged slander uttered by him against the plaintiff, came on for hearing. The litigation arose in connection with some statements made by Ward at a meeting of gas workmen held in May last; plaintiff being one of the men taken on by the above Company when their old hands threw up their work on the occasion of the strike. Defendant denied having uttered the slander; but said if he had, it was not done maliciously.

Mr. MURPHY, Q.C., and Mr. MEWS appeared for the plaintiff; Mr. T. TERRELL for the defendant.

Mr. MURPHY, in opening the case, said the action had only been brought by plaintiff to vindicate his character, and to put a stop to the persecution to which he had been subjected. Prior to the strike of gas workmen in 1889, plaintiff had been employed by the Salford Corporation; but he left their employment, and took service with the South Metropolitan Gas Company. As a result of his action, he was described as a "blackleg," and became a marked man. On May 7, 1891, speaking at a meeting of Union men, in Blackwall Lane, East Greenwich, defendant made imputations on plaintiff's character which, it was admitted on the pleadings, were absolutely without foundation. The words complained of were these: "There is a man working for Joe Tysoe [the Superintendent of the Company's East Greenwich station] named Higgins, whom and whose parents I have known for nearly 30 years. He is nothing but a common thief and a street-corner boy, who would rob any hard-working man of his wages or his watch and chain if he were lucky enough to have one, especially if he saw the man was drunk. He knows the cells inside Strangeways Goal better than he knows the retorts in the gas-works. I remember on one occasion, when he was taken into custody, when searched there were over 40 pawn-tickets upon him relating to stolen watches and chains which he could not account for." These statements were altogether untrue. The matter having come to the knowledge of the Directors of the Company, the plaintiff was asked to explain it; and thereupon he told the truth. The Directors accordingly ordered their Solicitors to assist him in bringing the present action. They wrote a letter, and the answer to it was that the defendant had never referred individually to the plaintiff in most of what was said; and that the statement was as to the class of men to which the plaintiff belonged. He did not know the plaintiff personally; and he had simply stated the effect of the report he had received. The learned Counsel concluded by saying that even at this stage of the proceedings his client would be willing to accept an apology; but, if this were not tendered, the jury must say at what amount they ought to assess the damages.

Justice DENMAN asked whether it was to be peace or war.

Mr. TERRELL replied that the case must go on, as he had no instructions to tender an apology.

Plaintiff was then called, and stated that he entered the service of the South Metropolitan Gas Company in December, 1889, having worked for the Salford Corporation for 16 years. There had never been the slightest suggestion of dishonesty against him. He was once fined 2s. 6d. for being drunk.

Cross-examined by Mr. TERRELL: He had been employed by the Company to get them labourers. He heard of the speech from a fellow-workman on the same day.

William Drain, a constable in the Metropolitan Police, examined, said he was present at the meeting on May 7, and heard the defendant say plaintiff had never done a day's work in his life, and was a street-corner boy and loafer. He would stand about and rob any hard-working man of his week's wages or his watch and chain, if he were lucky enough to have one; and he knew the cells in Strangeways Gaol better than the retorts in gas-works. He had often been convicted, and on one occasion, when he had been taken into custody, upwards of 40 pawn-tickets were found on him relating to stolen watches and chains which he could not account for. He (Ward) had known plaintiff's father for 20 years as a hard-working, honest man, and all the rest of his family. Plaintiff was the only black sheep in the flock.

Cross-examined: There had been a procession, and he had followed it to the place of meeting. He was about ten yards away from the defendant when he was speaking. He took no notes of the proceedings. About a week after the meeting, his Inspector asked him to put down what he remembered having been said about the plaintiff. He did so. There were three other policemen at the meeting. He did not consult the other men before he made his note. He had probably talked about it since. He did not hear defendant say he did not know plaintiff, or that what he was telling the meeting was only what he had heard about plaintiff in Manchester. He did say he was not sure about all he had said.

Justice DENMAN, having read the note made by witness, found the word "thief" was used.

Witness: Defendant said plaintiff was a thief and a scamp.

Police-constables *Aylward* and *Angell* gave similar evidence. They stated that defendant said plaintiff was a disgrace to his family, and would get hold of a man's watch and chain if he could. He was known as a thief and street-corner boy.

Cross-examined: Defendant spoke well of plaintiff's father and uncle; and did not say the plaintiff was reported to belong to a gang who did these things, but that plaintiff himself did them. They (the policemen) thought from what they heard that plaintiff was a man to be watched. The remarks were not made as showing the class of persons employed by Mr. Livesey.

Police-constable *Cullum* gave similar evidence.

Cross-examined: The police all made their written reports in the same room at one time. They might have been talking about what had been said on the occasion. Each man wrote what he remembered. They did not read over their reports to one another.

This was the case for the plaintiff.

Mr. TERRELL, in opening the defendant's case, said that the defence would be a complete denial that the words complained of had been used. It was clear that the police evidence had been agreed upon, and that the action was really one by the Directors of the Gas Company against the Union.

William Henry Ward was then called, and said he had been a gas stoker for 23 years, and was now Assistant-Secretary of the Gas-Workers' Union. He remembered what he stated at the meeting in question. He said: "There is at present working for Joe Tysoe a man named Higgins, whom I have never seen in my life, but whose father and uncle I have known for years. If the account I received of young Higgins in Manchester is correct, all I can say is that he has disgraced an honourable and honest parent; for a better foreman than old Dick Higgins I never knew. I have been informed that Higgins belonged to a gang who loitered about the Regent Road Barracks on pension-day, watching the pensioners. This gang knows more about the inside of Strangeways Gaol than about the inside of a retort. How true this is, I cannot say; I give it you as I received it. But if the information is correct, it proves to me that the South Metroplitan Gas Company don't care who they employ to bring them in anything in the shape of humanity at £1 a head. At one time, when a raid was made on the gang, 40 pawn-tickets for watches were found on them." He did not call the plaintiff a thief, or any of the other things complained of. He said that the gang, and not the plaintiff, had done all these things.

Cross-examined by Mr. MURPHY: The Gas Company were ready, and are even ready now, to take anyone who will work for them, whether he be a thief or not. The gang he mentioned were bad characters—street-corner boys and loafers, who picked the pockets of pensioners and others. He did say he had heard plaintiff was a member of this gang, who picked pockets.

John Fitch, the chairman of the meeting, said the police were outside the crowd. Defendant began by saying that, if the information he received was true, plaintiff was a disgrace. He did not hear the words complained of. He should have heard them, he thought, if they had been used.

Thomas Blackburn said he called the meeting, and stood near Ward with a banner. Defendant said that, if what he heard about the plaintiff was true, he had disgraced his parents. Defendant did say plaintiff's character would not bear investigation, and that he was an agent for procuring blacklegs. Defendant also said plaintiff was an associate of street-corner boys. "Watches and chains" were mentioned in connection with the class of men employed by Mr. Livesey.

Counsel having addressed the jury,

Justice DENMAN, in summing up, said defendant had himself admitted having said that the plaintiff was one of a gang of thieves. The mere fact that he had been told what he said was no defence. The evidence of the police was very strong; their attention having been drawn to the matter on account of the language used about the plaintiff. If, in substance, the words complained of in the statement of claim were made out, the verdict should be for the plaintiff. He could not say that this was not a very serious slander, as systematic dishonesty of a very low character was charged against the plaintiff. At the opening of the case, Mr. Murphy, on behalf of the plaintiff, said he was willing to accept an apology. But defendant's Counsel had been instructed to fight the matter out; and now the question of damages would be on a different footing. The jury must consider what sum would mark their opinion that the attack was an unfounded, unfair, and cruel one.

The jury almost immediately found for the plaintiff—damages £200.

His Lordship gave judgment accordingly; certifying for a special jury.

COUNTY OF LONDON ASSESSMENT SESSIONS.

Sessions House, Clerkenwell, E.C.—Monday, Jan. 11.

(*Before Sir* P. H. EDLIN, Q.C., *Chairman, and a Bench of Magistrates.*)

The Gaslight and Coke Company's Assessment Appeals.

Representatives of the parties concerned in these appeals attended to-day for the purpose of answering certain questions to be submitted by the Court.

The CHAIRMAN said he wished to obtain from both sides answers to questions which he proposed to put for the speedier determination of the case. First of all, was the Court to understand that the parties were all of opinion that, with regard to the distribution of the rateable value of the productive mains, the Court should consider the proportion which the gross receipts in each Union bore to the total receipts, and in the same proportion distribute the rateable value of the whole as between the parishes? He apprehended that this was conceded on both sides.

Mr. POLAND: I understand that, when your Lordship has arrived at the total value of the whole, and deducted the indirect portion, so as to get at the total value of the direct portion of the whole, then, according to the Mile End and West Middlesex Water-Works cases, the total amount of the indirect portion would be divided among the different parishes proportionately to the total receipts in those several parishes.

The CHAIRMAN: I think this would be an accurate formulation of the procedure: The distribution of the rateable value must be proportionate to the receipts in each parish; that is to say, in the same ratio or relative proportion as the receipts in each parish respectively bear to the total gross receipts of the Company.

Mr. LITTLER: Quite so.

Mr. POLAND: The proportion should certainly be before the rates are deducted.

The CHAIRMAN: There may be questions of arithmetic to be determined after we have found the rateable value; but the proper rateable value cannot be arrived at until we have calculated the amount of rates for which the Company would be entitled to have credit. Then, when we find the amount from which the rates would have to be deducted, we may have to ask the assistance of the accountants in doing the necessary sums as between the parishes.

Mr. LITTLER, Mr. POLAND, and Mr. FULLERTON assented on behalf of their clients.

Mr. MARSHALL: I assent, with this qualification, if it is one—that the proportion shall be taken first, and the rates deducted for each parish separately afterwards, because the local rates differ as between themselves.

The CHAIRMAN: The rates would have to be considered subsequently, and deducted according to their respective amounts in each of the Unions or parishes. Then I take it that, in the valuations which we have had from the several professional gentlemen called before us, the rateable value of the stations, and what are coupled therewith under the heading of unproductive or indirectly productive mains, has been deducted by each of the valuers from what he presents as the rateable value of the productive mains.

Mr. LITTLER: That is so.

Mr. POLAND: I am afraid that it is not quite so.

The CHAIRMAN: Are the several localities supplied with gas from those stations distinct, or are they intermingled in such a way as to render it impossible to attribute a rateable value to the mains indirectly productive which are fed from the several stations separately?

Mr. LITTLER: It is quite impossible, my Lord.

Mr. POLAND: I think all the valuers take the view your Lordship has presented—that, a number of separate undertakings being brought up by one great Company, they are intermingled, and worked together.

The CHAIRMAN: Then we have not to trouble ourselves with any such separation?

Mr. POLAND: No; it is on the whole.

The CHAIRMAN: There is another question, and a nice one, to which I have to draw your attention. The parishes in which the several stations are situated have agreed with the Company; and there has been an accord as to the value of each of the stations.

Mr. POLAND: No, my Lord.

Mr. LITTLER: I am told that St. Pancras has not agreed.

The CHAIRMAN: We have had no evidence as to the value of the St. Pancras station.

Mr. POLAND: It was agreed, first of all, that your Lordships should decide the main question of the total of the value of the Company's property so far as the indirect portion is concerned.

The CHAIRMAN: Then our decision in the first place would be only an interlocutory judgment.

Mr. POLAND: Yes, my Lord.

Mr. LITTLER: If we get a decision of the main question, I hope we should have little or nothing to trouble the Court about. We should certainly endeavour to agree to anything; and all we should have to do would be to come, as they say in the Court of Chancery, for further directions.

Mr. POLAND: If we had this great main question decided, it was the hope, not to say the belief, of several of the parishes which have works their area, that we should be able probably to come to some agreement.

The CHAIRMAN: Then Mr. Littler puts it correctly—you would have to come for further directions?

Mr. POLAND: Yes.

The CHAIRMAN: And the accountants would have something to do in distributing the amount which we may find?

Mr. FULLERTON: That is it, exactly.

The CHAIRMAN; The settlement, as far as I understand it, between the parishes and the appellants in respect to the stations was arrived at, not upon the basis of the account year, but upon that of the figures as they were originally presented for the purpose—that is to say, for the current year ending Dec. 31, 1889. You have agreed between you not to reopen that question; but, in dealing with the entire value, it strikes me as possible that there may have been a disproportionate appropriation of value to those stations. If there has been any disproportion, inasmuch as their value was considered before we entered upon the arbitrament of the values of the works, there may be some differences to be considered.

Mr. LITTLER: I think not, my Lord; I consider the value would be the same in the account year as in the current year.

Mr. POLAND said some of the valuers for the respondents did not agree with the appellants as to the values of the indirectly productive portions of the stations; and the Court would have to decide the point upon the evidence.

Mr. DANCKWERTS said the difference between Mr. Ryde and Mr. Jones was only a few hundred pounds in a matter of £16,000.

Mr. POLAND: Your Lordship should, in a broad view, take the various valuations put before you by the different surveyors.

The CHAIRMAN: I wish it were generally understood what is the variation. As between the lowest valuation on the part of the appellants and the highest on that of the parishes, there is a difference of £600,000, or, if the rates were only 5s. in the pound, of a possible rateable liability of £150,000 a year. If we take the highest valuation on the part of the appellants, and the lowest on that of the respondents, there is a difference which, calculating the rates at 5s. 2d. in the pound, would result in £56,000 a year. There is another question I wish to ask. Some of the mains fed by these stations within the area extend out of the area in which we are exercising jurisdiction. I want to know whether this has been taken into consideration, or whether, after we have found the value, it may be sprung upon us that there should have been deductions in respect of those. This is a fundamental question; and it occurred to me that it should be cleared up. We might be distributing among the respondent parishes the receipts of the Company, a portion of which would be rightly applicable to property for which they have to pay rates out of the area.

Mr. DANCKWERTS: All the valuers have taken the whole of the concern as one, wherever situated.

Mr. POLAND: Your Lordship has the very difficult duty of dealing with all the property within your own jurisdiction; and to get at this you cannot help taking it as a whole.

The CHAIRMAN: Then I understand that the accounts do include those parishes which are external to the area, and that it is conceded on both sides that no injustice will be done by our apportioning the values accordingly.

Counsel present assented to this.

MISCELLANEOUS NEWS.

METROPOLIS GAS SUPPLY.

The Quality of the Gas in the Past Quarter.

The following is an abstract of the report of the Chief Gas Examiner for the Metropolis (Dr. A. W. Williamson, F.R.S.) as to the quality of the gas supplied by The Gaslight and Coke, the Commercial, and the South Metropolitan Companies, during the quarter ending the 31st ult.:—

I. *With respect to Illuminating Power.*—The average illuminating power, in standard sperm candles, at each of the testing-stations, was as follows:—

The Gaslight and Coke Company—	
Fenchurch Street, E.C.	16·4
Cloth Fair, E.C.	16·5
Dorset Buildings, E.C.	16·4
Ladbroke Grove, W.	16·4
Devon's Road, E.	16·4
Carlyle Square, Chelsea, S.W.	16·2
Camden Street, N.W.	16·4
George Street, N.W.	16·2
Graham Road, E.	16·5
Kingsland Road, E.	16·2
Spring Gardens, S.W.	16·4
Grove Gardens, Regent's Park, N.W.	16·1
Hornsey Road, N.	16·5
Lambeth Road, S.E.	16·2
Millbank Street, S.W. (cannel gas)	21·1
Commercial Gas Company—	
Parnell Road, E.	16·2
Wellclose Square, E.	16·2
South Metropolitan Gas Company—	
Hill Street, S.E.	16·5
Foster Place, S.W.	16·1
Stoney Lane, S.E.	16·3
Lewisham Road, S.E.	17·1
Burrage Road, S.E.	16·1
Blackfriars Road, S.E.	16·3

It will be seen from these results that the average illuminating power of the gas has been higher than the parliamentary standard at all the testing-stations. At the Cloth Fair, Dorset Buildings, Ladbroke Grove, Devon's Road, Camden Street, Kingsland Road, and George's Street stations of The Gaslight and Coke Company, and the Lewisham Road station of the South Metropolitan Gas Company, the minimum illuminating power was equal to the requirements. At Millbank Street and Graham Road, it was better than the requirements of the Acts of Parliament; and it was below them at the Fenchurch Street, Carlyle Square, Spring Gardens, Grove Gardens, Lambeth Road, Hornsey Road, Wellclose Square, Parnell Road, Hill Street, Bedford Road, Stoney Lane, Blackfriars Road, and Burrage Road stations.

II. *As regards Purity.*—Sulphuretted hydrogen was reported by the Official Gas Examiner to have been present in the gas tested at the Wellclose Square station of the Commercial Gas Company on the 28th of December. The average amount of sulphur in other forms than this was considerably lower than the limit allowed (viz., 22 grains) at all the testing-stations of the three Gas Companies. With the exception of the Hill Street and Bedford Road stations of the South Metropolitan Gas Company, the maximum amount of sulphur present in the gas at all the testing-places was within the above-mentioned limit. Ammonia has been generally present in the gas throughout the quarter more or less frequently at all the testing-stations, but only in slight quantities. The limit allowed was not exceeded on any occasion during the quarter.

THE EXTENSION OF THE ROCHDALE CORPORATION GAS-WORKS.

At the recent Monthly Meeting of the Rochdale Town Council (as briefly mentioned in the JOURNAL last week), Alderman W. J. Petrie, in moving the adoption of the minutes of the Gas Committee, made an important statement on the present position of the gas-works, and the proposals for future extension. He first referred to the use of inclined retorts and the manufacture of oxygen for the purpose of purification. The inclined retorts, he said, saved time in charging and drawing; and the Engineer (Mr. T. B. Ball) calculated that the saving amounted to 9d. per ton in labour on the fuel used. These advantages were not unalloyed. There were some little drawbacks still in the process—such as the unequal heating of the retorts, which had bad effects in several ways. Fortunately they could gain practical experience from the inclined retorts they had in use, so that, when the time came to determine what kind of retorts to place in the new house, they would be able to decide of their own knowledge. As to the other process he had mentioned, they were now manufacturers of oxygen for use in purifying the gas. In one respect the system did not do all that was anticipated—it had not raised the illuminating power of the gas. The makers of the apparatus said that this was owing to the fact that it was not large enough; and it was now for the Committee to say whether it should be enlarged. The gas now contained only 10 grains of sulphur per 100 cubic feet of gas, whereas it used to contain 30 grains; and it was one of the purest, if not *the* purest, illuminating gas that was made in the country. With regard to the new works, the first intention of the Committee was to make all the extensions and improvements on the land now in the possession of the Corporation; but they found that, owing to the watery state of the land, it would be very costly to erect a new holder on it, besides so disturbing the land that there might be a collapse of a large portion of the works. When this became evident, the Committee looked round for a new site for the holder; and they fortunately found one only separated by a short distance from the present works. It contained an area of between 9000 and 10,000 square

yards; and they had been able to purchase it at a reasonable price, subject to parliamentary approval for its use for manufacturing purposes. It was excellently adapted for two large gasholders, which would each contain 1,500,000 cubic feet of gas. Then the ideas of the Committee developed; and they felt it would be desirable to seek powers for manufacturing on two or three other plots of land. Much more room was wanted for the storeage of residuals; and larger mains were also required in the centre of the town. Proceeding, Alderman Petrie said they proposed to erect another retort-house, capable of holding 266 mouthpieces. The present works contained 417 mouthpieces; so that there would be an increase in the producing power of 64 per cent. Curiously the increase in the quantity of gas made was, within a fraction, exactly the same in the past decade as in the ten years preceding. From 1881 to 1891 the increase was 41·6 per cent.; while from 1871 to 1881, it was 41·7 per cent. If they might rely on a similar increase in the next ten years, two-thirds of the increased production would be absorbed; and they might reckon that the new works would last from 15 to 20 years. Summing up, he said that the cost of the proposed extensions was roughly estimated as follows: Gasholder, 150 feet in diameter and 100 feet high, £13,000; tank for the same, £9000; retort-house, coal-stores, and approaches, £13,500; retort-stack, hydraulic and foul mains, pipes, valves, and fittings, £12,000; boundary walls, paving, draining, levelling, &c., £2500; new sewers, diversion of drains, &c., £500; new exhausters, connections, and foundations, £1000; new smiths' and joiners' shops, £800; removal of meter shops, stores, &c., £1500; part cost of enlargement of mains (the other part to come from revenue), £2000; connections to present plant, valves, &c., £500; contingencies, £2700—making a total of £60,000. If they decided not to have inclined retorts, but to go in for mechanical charging machinery, there would be an additional cost of £6000. This appeared a large sum to add to the capital of the gas-works; but if they compared figures, they would see that it was nothing to be alarmed at. In 1881 the mortgage debt on the gas-works was £164,956, or £620 16s. of capital per million feet of gas made. In 1891 the debt was the same; but the production had so increased that the proportion was reduced to £438 14s. per million feet. If the £60,000 were added to capital account immediately, and there was no increase in production, the capital per million feet would be considerably less than it was ten years ago. After a brief discussion, the minutes were adopted.

THE BIDEFORD TOWN COUNCIL AND THE GAS COMPANY.

The Gas-Works Purchase Question—Opposition to the Company's Provisional Order.

A Meeting of the Bideford Town Council was held yesterday week to consider the grounds of opposition to the application of the Gas Company to the Board of Trade for a Provisional Order. The Directors of the Company met specially on Jan. 9 to consider the proposal of the Town Council that negotiations for the purchase of the gas-works should be entertained under clause 2 of the Electric Lighting Act; and, in view of this, they passed resolutions to the effect: (1) That they were advised that clause 2 of the Electric Lighting Act of 1882 had no application to the matters in question; and they renewed their offer to sell at a valuation in the usual way. At the same time, having regard to the peremptory need for the extension and protection of their works, they considered it was imperative upon them to proceed with the application in the absence of any definite agreement by the Council to purchase. (2) That to suspend their application until 1893 and cripple their undertaking for the whole year, they argued, would be not only impolitic, but unjust to their consumers. (3) As an evidence of their *bona fides*, the Directors were willing to allow their offer to remain open until Feb. 1 next, though they reminded the Council that they had notice of the intended application in the month of August last, since which date the public meeting of the ratepayers had been held, and ample opportunity afforded to the Council to decide upon the question of purchase. The Directors regretted that any attempt to treat for their works should have been left until the eleventh hour, when heavy expenses had been incurred, and the regulations of the Board of Trade complied with; and that to suspend or abandon their application now would, they observed, involve an unjustifiable sacrifice of the shareholders' money. After these resolutions had been read at the meeting of the Council, Mr. Marraway remarked that, since the Company would not suspend their application for a Provisional Order, the Corporation must not suspend their opposition. He suggested an amendment, which was agreed to, that the local authority proceed "with the approval of the ratepayers" to apply for an Order on their own account. The objections to the Company's Order were then carried unanimously, as follows: (1) That the Gas Company does not efficiently and properly supply the public and private consumers of the borough with gas. (2) That the prices charged by the said Company are excessive and unreasonable, and in excess of the rates provided by the legal settlement under which the Company was constituted. (3) That the local authority are of opinion that it is desirable that the lighting of the town, whether by gas or ultimately by electricity, should be in their control, as well as the water supply, which is already in their hands. (4) The said local authority intend and propose, with the approval of the ratepayers, before the next session, to apply themselves for a Provisional Order, or for a Private Act to obtain the control of the lighting of the town, and for this purpose to acquire the rights and property of the existing Company. (5) That if it be deemed expedient, an inquiry be held by the Board of Trade before a Provisional Order is granted. Two other resolutions were afterwards passed, and added to the objections—one being "That the general condition of many of the old gas-mains in the streets renders it necessary to frequently break up the streets, to the interference with traffic and destruction of metal;" and the other was to the effect that the control of the Council over the sewers in the streets should be undisturbed, as any interference by the Gas Company would be fraught with much danger from a sanitary point of view, prejudicial to the health of the town. At a later stage in the proceedings, it was decided that a premium of £25 should be offered for a report on the practicability and cost of installing the electric light in Bideford.

GAS AND WATER AFFAIRS IN BRUSSELS.

Our readers are aware that the question of the price charged for gas in Brussels has lately been very much under discussion, both in the Municipal Council and among the citizens. A bold proposition was brought forward a few months ago by M. Richald to abolish differential prices, and make the charge 12c. per cubic metre (about 2s. 8½d. per 1000 cubic feet) all round, irrespective of the purpose for which the gas was to be used. To compensate for the deficiency in the municipal revenues which would follow this reduction, it was suggested to impose a lighting-tax, to be levied upon the householders according to the frontage of their premises upon the public thoroughfares. These proposals, it will be remembered, were rejected in favour of one introduced by M. Allard, retaining the charge for gas employed for lighting purposes at 14 c., and making the figure 10c. for that used for cooking, motive power, &c., provided the consumer took the supply through a separate service-pipe and meter. The Brussels Municipality (or rather the Gas Committee of that body) have been conspicuous among gas-supplying corporations for their efforts to extend the use of gas for other than lighting purposes. Petroleum is a very powerful competitor with gas as an illuminant in the city, as every visitor to Brussels knows perfectly well. And it is not consumed in the cheap, dangerous lamps which are too frequently the cause of fatal accidents in this country, but in well-made, artistic appliances, which are much favoured by shopkeepers. The Committee have therefore endeavoured, by every possible means, to encourage the more liberal use of gas for both lighting and heating; and the proposed reduction in price to 12c. was the natural sequel of their previous efforts. As this was rejected, the adoption of the other proposition was the only possible course under the circumstances. This question of price will in all probability crop up again; for the Committee will not be able to relax their exertions to make the gas-works pay their way. Writing on this subject recently, a Brussels correspondent remarked that progressive reductions in price are absolutely necessary in Belgium; in fact, if these had not been conceded in Brussels, the financial condition of the municipal gas undertaking, owing to the falling off in the revenues, would have been much worse than it now is. Notwithstanding the severe competition of petroleum already referred to, he considers the future will be good for gas; everything indicating that its consumption will go on increasing without interruption. This extended use of gas should be encouraged by reductions in price judiciously made. Heating and cooking by gas have now become quite general in the city, owing to the hiring-out system in operation there. The municipal authorities charge a very moderate rental for the stoves, which they fix free of expense to the consumer, who is, of course, relieved of all the outlay necessary for a purchase outright. Stimulated by the action of the Gas Committee, the makers of gas appliances have adopted some very appropriate patterns of stoves; and consequently the consumers benefit to a very large extent from these combined efforts. Already important installations of gas cooking appliances are in operation in the principal hospitals of Brussels and Liège, as well as in several large popular establishments. The initiative in the placing of these stoves was due to the Gas Committee. In addition to lending gas-stoves on hire, many gas managers in Belgium adopt this plan with high-power burners; the object being, of course, to extend a system of lighting which every day gives evidence of possessing many advantages.

Reference has already been made in the JOURNAL to the monthly conferences held by the members of the Belgian Association of Gas Managers. At the most recent of these gatherings, M. Boscheron, Engineer of the Liège Gas-Works, the President of the Association, discoursed on the heating of gas-retort furnaces. The Committee of the Association have been somewhat warmly discussing the relative merits of blue and white flames employed in gas cooking and heating appliances. This much-debated question was worth dealing with in a public meeting, so that those who had a direct interest in it—viz., the makers of gas-stoves—might have gathered some information from the various views expressed. The Committee preferred, however, to conduct their proceedings with closed doors; other considerations besides purely scientific ones probably being taken into account. At the permanent exhibition of gas appliances on the Boulevard du Nord, stoves having burners giving blue flames are the more numerous; and they are patronized by the Gas Company at St. Josse-ten-Noode, one of the suburbs of the city. The Municipality of Brussels appear to give the preference to white flames; and the magnificent collection of stoves of this class to be seen at their depôt in the Rue du Chêne certainly justifies their choice. Referring to this question, the correspondent already mentioned remarks that if the blue flame is in its proper place in a roaster or kitchener, it must be confessed that for ordinary household affairs it frequently gives rise to disadvantages which enable its rival to easily bear away the palm. In a general way, a stove pleases when it lights up well; but regarded from the points of view of consumption, hygiene, and cleanliness, it must be acknowledged that there are some good stoves, in which the heat is obtained by reflection from flames that are in part directly luminous, which go a long way towards meeting the desired object.

Important as is the gas question in Brussels, that of the water supply of the city is much more so; the health of the public and the municipal exchequer being both affected thereby. The city proper contains 180,000 inhabitants; and its suburbs, 350,000. Many years ago, the Municipality and the outside districts entered into an agreement under which the former should supply water to the combined area. But this arrangement, which formerly answered very well, is no longer adequate to the requirements of the increasing population in the outskirts, and these people complain of the short supply of water they receive, and of the high price they have to pay for what does reach them. At the commencement, the Municipality distributed 10,000 cubic metres (about 2¼ million gallons) of water per day. At the present time, 35,000 cubic metres—drawn from wells or from the drainage area—are sent out; and 20,000 or 30,000 cubic metres more are needed to adequately meet the demands of what would be regarded as a good distribution. The city water, which is perfect for culinary purposes, is unsuited for industrial use. As the latter constitutes two-thirds of the total consumption,

only 25,000 cubic metres of potable water are required for Brussels itself; the remainder being furnished by water of rather lower quality. According to the Municipal Council, all that is required is to procure an additional supply by drawing from a river or a stream. The 28,500 consumers take, on an average, 20,000 cubic metres of water for domestic purposes—a quantity which is evidently inadequate, since it comes to only about 70 litres (15½ gallons) per head per day. There should be provided at least twice this quantity for a more numerous population than that which now exists. As to the charge, this is felt to be too high; for an annual minimum of 27 frs., *plus* 12 frs. for the hire of the meter, comes to 65c. per cubic metre, or about 3d. per 100 gallons. The outside districts interested, tired of waiting for a supply more proportionate to the bulk of the population, and at a more reasonable figure, have formed a federation with the object of procuring for themselves what they require. Several projects are to the front. The Modove scheme would furnish daily from 75,000 to 85,000 cubic metres of water, which, with the quantity now available, would be equal to the 150 litres already mentioned, supposing the expected increase of population should take place. The net price at the central reservoir would be 4c. per cubic metre; and the total cost of the scheme, 15,000,000 frs. Each commune would agree to take a minimum quantity of 150 litres per inhabitant; and the water would be sold so as to yield a profit, which would be applicable for the public service. The new combination, while furnishing a much more considerable volume of water than that now available, will not entail on the consumers a greater outlay than 375,000 frs. The project is one of double canalization, conformably to the principle adopted by the city; and this system will probably allow of a very material reduction in the price charged. The Société Intercommunale des Eaux of Brussels are also bestirring themselves. The Society is a legally constituted body, and comprises among its shareholders the most prominent members of the Councils of the four principal communes. Application was made to the Government for the nomination of one of the Engineers of the Ponts et Chaussées to the position of Director-General of the Society; but the Government declined. Several gentlemen connected with industrial undertakings have therefore put up for the post; and the decision of the Board is now awaited.

ELECTRIC LIGHTING FOR PORTSMOUTH.

A New Scheme.

In compliance with the instructions of the Electric Lighting Committee, Professor William Garnett has submitted to the Portsmouth Town Council an estimate of capital and current expenditure and receipts for the lighting of the district specified in Schedule B of their Provisional Order, and of the Esplanade between the two piers. The estimate is based upon the assumption that alternating currents at a pressure of 2000 volts will be employed for the transmission of energy through the main leads, and that "turbo-electric" generators, with surface condensers, will be employed. The first portion of the report refers to the conductors to be used; and then it states that, for the purpose of public lighting in the streets, instead of arc lamps, placed at distances of 50 yards or more, the Professor prefers to employ "high-efficiency" incandescent lamps of 150-candle power, fixed at distances of about 30 yards. These lamps would be supplied directly from low-tension conductors; and two of them would require about the same power as a single arc lamp. They would need to be more frequently renewed than ordinary incandescent lamps; and this has been taken into account in the estimate of annual expenditure. The capital required for an installation of 8800 private lamps and 200 public lamps is estimated at a little more than £38,000; and Professor Garnett reminds the Committee that it is desirable that borrowing powers should be obtained for a much larger sum, in order to enable extensions to be made to the system from time to time, as the public may demand, without renewed application to the Local Government Board. The cost of the site is an item not included in the capital estimate. So long as the number of private lamps wired is less than the equivalent of 8800 60-Watt lamps, the income, says the report, will be less than the amount estimated, and the expenses will also be less, but not in the same proportion. There appears, however, to be a reasonable margin to meet this difference; and if the public lighting is undertaken at once, the installation may be expected to pay its working expenses and interest on capital actually invested as soon as the number of private lamps wired exceeds 5000. Professor Garnett's estimate of the capital needed for high speed generating plant and incandescent lamps for public lighting is £38,285. He places the annual receipts for private and public lighting at £10,800; and the expenditure, including interest on £40,000 at 3½ per cent., at £7572.

At the last meeting of the Town Council, the Electric Lighting Committee recommended that the resolution of the Council passed on Sept. 8 last, so far as it referred to the adoption of Mr. J. N. Shoolbred's scheme,* be rescinded, but that this should not apply to so much of the resolution as referred to the borrowing of £60,000. They further recommended that the scheme and report of Professor Garnett be adopted, and that he be appointed Consulting Engineer, and that Messrs. Waller and Mandeville be appointed Superintendent Engineers; the fee for the Consulting and Superintendent Engineers to be £1500 together. With a view to carry out the scheme embodied in Professor Garnett's report, the Committee recommended that they be authorized to acquire a site for the central station. Alderman Ellis moved the adoption of the report, and briefly related the circumstances under which the Committee abandoned the plan submitted by Mr. Shoolbred for the one that was now presented. He said that Mr. Shoolbred had given an estimate of the annual income to be derived from the electric light and also the expenditure. But before a definite arrangement had been arrived at, a doubt arose as to whether he had not overestimated the revenue; and the Committee invited him to meet them and prove that his figures were correct. He failed to satisfy them; and they had no alternative than to dispense with his services—it being clear that he had not taken into consideration the nature of the town. Professor Garnett was called in for consultation; and he expressed an opinion that Mr. Shoolbred's estimate of £10,000 was £2300 more than could be reasonably anticipated, it being unlikely that they could earn more than £1 for each lamp wired. Moreover, it would be impossible to extend the light beyond the area contained in the Provisional Order without ruinous cost. Mr. Beal having seconded the resolution, Mr. Miller observed that only four months ago the Committee assured the Council that, in making a selection of Mr. Shoolbred's system, they were perfectly right and safe; and he asked what justification had they now in making a similar representation with regard to Professor Garnett's plan? He moved, as an amendment, that the consideration of the report be deferred to an adjourned meeting of the Council. Mr. Fulljames seconded the amendment. The Mayor remarked that the Committee had adopted Mr. Shoolbred's scheme on the strength of a report received from a deputation which visited Bradford. The deputation, of which he was one, were delighted with what they saw of the installation in operation there; but they overlooked the fact that Bradford was a compact town, with all the business houses in one centre, whereas Portsmouth was a scattered borough, for which the low-tension system was wholly unfitted. On the amendment being put, it was carried by 16 votes to 12.

* See JOURNAL, Vol. LVIII., pp. 500, 535.

STOCKTON AND MIDDLESBROUGH WATER BOARD.

The Progress of the Undertaking.

At last Tuesday's meeting of the Middlesbrough County Council, Alderman Bell, in moving the adoption of the report of the Water Board, made an interesting statement regarding the work of the latter body and the prospects of their undertaking. Referring, in the first place, to the question of the rateable value of the undertaking, he said that it had been greatly increased. The Board had contested the assessments over and over again, sometimes with favourable results, and sometimes with unfavourable; but now the rates paid by them had been advanced by 50 per cent. When they came into possession of the undertaking, they found themselves in receipt of a revenue of £40,000 per annum; and this had increased until it now reached upwards of £60,000. This increase was entirely due to the growth of the district and the enlarged demand for water. At that time the net sum received by the Board in respect of every 1000 gallons of water was 3·98d; but at present they were receiving slightly more than 4½d. The members might think it odd that the increase of the revenue was due to the growth of the district and not to the increase in the charge; but this, nevertheless, was the case, because when the Board came into possession, they found that a very large proportion of the water pumped never reached the consumer, but was wasted, and the increase in the revenue was due entirely to the saving of that waste. With regard to the supply of water for manufacturing purposes, the Board inherited from the Water Company a very anomalous position—that of being obliged to supply water at 3d. per 1000 gallons if a certain quantity was taken, under which condition small consumers could by running hundreds of thousands of gallons to waste actually get their water cheaper than by taking only the smaller quantity; and the Board became aware of cases where this course was being pursued. They had, however, revised the scale with the best results. The cheapest water they sold was at 3d. per 1000 gallons; and upon this they had a balance of 1⅞d. towards interest and redemption. Turning to the domestic supply, he remarked that when the Board first became possessed of the works, they derived something under 4d. per 1000 gallons, and now they were deriving 7·02d. This advance in the profit was not owing to an increased charge to the consumers, but was the result of economy in the working of the undertaking; and this was one of the strongest testimonies to the way in which the affairs of the Board had been administered. As to the future of the undertaking, at the present moment they were on the eve of bringing the supply from Hury, which had only been prevented by the unpropitious weather. The Blackton reservoir was also progressing rapidly; and he had no fear, with the steady growth of the district, that the water undertaking during the next 15 years would be a continually improving property. In conclusion, he said that the water supply of the district was quite unique—two-thirds of it being required for manufacturing purposes; and he was one of those who believed that a not unimportant element in their prosperity was the fact that they possessed so admirable a supply of water for manufacturing purposes. The report was adopted.

The Purchase of Water-Mains by the Kirkleatham Local Board.

On Wednesday, the 6th inst., arbitration proceedings were commenced at the Surveyors' Institute, Great George Street, S.W., to determine the amount to be paid by the Kirkleatham Local Board to the Stockton and Middlesbrough Water Board for the water-mains and privileges of the latter body in the Kirkleatham district. Mr. Henry Lord was the arbitrator appointed by the Local Government Board. The Water Board were represented by Mr. Balfour Browne, Q.C.; and Mr. Bagallay and Mr. Wood appeared for the Local Board. Among the witnesses examined for the Water Authority were Mr. D. D. Wilson (the General Manager), Mr. T. Fenwick, and Mr. Mansergh; and on the other side, Mr. W I'Anson and Mr. C. Hawksley. The case arose out of the compulsory sale under the Act of 1876 by the Joint Boards to the Kirkleatham Local Board of all pipes, mains, fittings, &c., in Kirkleatham. The Joint Board's claim, based on revenue, amounted to £29,000, and the sum offered by the Local Board was something over £4000, calculated on structural value; the real point at issue being the proper interpretation of section 4 of the Act. The proceedings were continued on Thursday, Friday, and Saturday, and concluded on Monday, when the Arbitrator reserved his award.

Extensions at the Bradford Corporation Gas-Works.—The minutes of the Gas and Electricity Supply Committee which were adopted at the meeting of the Bradford Town Council last Tuesday, contained a resolution recommending the acceptance of tenders for the construction of the roofing of a new retort-house at the Birkshall Gas-Works, amounting in the aggregate to the sum of £6166.

THE PURIFICATION OF WATER.

In the course of an address delivered by Professor LEEDS before the Chamber of Commerce of Rochester (N.Y.), he made the following remarks on the subject of the treatment of water by filtration.

I know of no method by which it is possible to render waters organically pure except by filtering; and I know of no practical method of bringing about this result except by the American system of mechanical filtration and purification. As these statements appear strong and unqualified, I think it is important that I should briefly review the history of our knowledge and practice during the course of the past ten years, in relation to this subject.

Some six years ago, there was, I think, but one city in the United States which attempted to filter its water, and that was Poughkeepsie on the Hudson. At the present day there are more than a hundred; and the practice is increasing very rapidly. In England and on the Continent of Europe the practice of filtration is well-nigh universal. Some five years ago, Jersey City and Newark, in New Jersey, requested me to visit the various water supplies (in England more especially), to study this matter of filtration of their waters; and I found that all the great cities, with the exception of Glasgow, filtered their water. The most conspicuous example is London, with its population of 5¼ million people. Its water supply is almost entirely taken from the River Thames, and that river receives the drainage of a very great population. The towns are compelled, by Act of Parliament, to purify their sewage to a certain point; but a great deal of filth finds its way into the Thames. By Act of Parliament, the several Water Companies that supply London are compelled to filter their water; and to effect this object they have filter-basins which cover more than 100 acres in area. Their method of filtration is to run the water into large reservoirs containing sand. The sand that does the filtering is about 2 feet in depth, and is supported on a substratum of coarse stone. As the filth is removed, it accumulates in a thin layer upon the top of the sand; and when the water—which filters only under the pressure of the 4 feet or thereabouts of water standing in the reservoir—filters too slowly, they are compelled to send a force of men into the basin, shovel off the top layer of sand and dirt, remove it, wash it, and restore it to the filter-bed. The same plan is followed in Berlin and other cities on the Continent.

It is easy to see how the men remove the dirt, the gravel, and the suspended matter; but how do these shallow basins of sand remove the living organisms—those organisms with which we are all so familiar under the name of bacteria, and which, when they produce typhoid and other fevers, are known as disease germs? This operation was a complete mystery until within the last four or five years. But few people had ever seen or examined bacteria before that period; and the method by which they were removed from the waters was a profound mystery. It has now been shown that the bacteria remove the bacteria. The bacteria in the waters are comparatively few of a dangerous character; the great bulk of them are our greatest friends. It is through their aid, together with the oxygen of the air, that the filth in the water is destroyed. They feed upon it, and they feed upon each other. Since that knowledge has been obtained, the object now is to cultivate the bacteria. In order to make the filter-bed do its work effectively, it is necessary that the growth of the bacteria shall be facilitated until a bed becomes populated with an incredible number of millions of them. As the result of their activity, they multiply themselves in vast numbers; and they form, at the top of the filter-beds and between particles of sand, a sort of jelly or slime—a bacteria jelly; and it is by the aid of this jelly that the bacteria in the unfiltered water are removed. The bacteria come down into the pores of the filter, when they are caught by this jelly and are consumed. And if the rate of movement of the water is slow enough, it is possible to begin with water like that of the River Spree, which is a portion of the supply of Berlin, containing 100,000 bacteria to the cubic centimetre, and after passing through one of the filter-beds, the water which comes out will contain but 40 or 50 bacteria. This takes place when the rate of filtration is such that a million gallons of water pass through these filter-beds per acre in 24 hours. If the rate is diminished until only 300,000 gallons pass through in that interval, the bacteria can be diminished until there are only 5 or 10 per cubic centimetre. But this rate is too slow to permit of the economical use of the filter-beds; and the consequence is that the authorities of Berlin require that the water shall pass through the beds at the rate of a million gallons per acre in 24 hours. The interesting fact is thus brought out that some of the foulest water—that most polluted with sewage—is filtered in this way at the present day in the capital of Germany. The filtered water is submitted to the most searching criticism of Professor Koch, to whose labour our knowledge on this subject is mostly due.

The foreign filter-beds, excellent as they are, have never been introduced practically in the United States. Moreover, there is no prospect that they will be. The amount of water filtered per acre is so small that the first cost is a large one. In the second place, the climate of Europe and of England is altogether different from that of America. The filter-beds freeze up, even in London; and the Water Engineers are sometimes greatly troubled. In the next place, in England, even in that temperate climate, a great quantity of *algæ* develop in the filter-beds. In the United States, with the severe winters and the great trouble experienced from the growth of *algæ*, engineers are unwilling to undertake such method of filtration. This being the case, their attention has been directed to find some way of effecting a result which will satisfy our own needs; and the system I shall bring to your notice in reference to your immediate wants is the American plan.

The filter is simply a case constructed of boiler-iron, 5, 10, or 20 feet in diameter, made strong enough to stand any pressure to which it is subjected. It contains a bed of sand 3½ or 4 feet in depth. The water is sent through the filter under pressure, and flows out of the bottom by a series of valves so constructed that they permit the water to pass, but entirely detain the sand. After a time, when the filth accumulates on the surface and through the bed of the sand, the operation is reversed—a current of filtered water under pressure is sent up from below, the sand is washed, and the impurities pass out from a waste-pipe. Then filtration is resumed. In practice, after working for ten hours, a filter can be purified by washing in ten minutes' time.

That it is possible, by such a method, to renovate the sand and dirt, you will probably have no difficulty in admitting; but what will such a filter do with reference to the bacteria? If it is necessary to pass water at so slow a rate where the pressure is as light as that given by a head of 4 feet, as is the case in the foreign filter-bed, how is it possible to pass the vastly greater quantity through one of these American filters? One of the filters of which I have been speaking, 10 feet in diameter, under a pressure of 15 lbs. to the square inch, will filter successfully 250,000 gallons per diem. In order to effect this result, it is necessary to have something which will take the place of the bacteria jelly I have described. And the most successful substitute is a jelly made of hydrate of alumina. It is obtained in this way: All natural water contains in solution carbonate of lime, to which its hardness is due. When sulphate of alumina is introduced into the water, it is decomposed by the carbonate of lime, and sulphate of alum is formed, and hydrate of alumina is set free. It is a perfectly white translucent jelly. It forms on the surface of the filter-bed in contact with the grains of sand; and when the smallest particle of silt or the bacteria come in contact with it, they are caught by it and held. It is possible to entirely remove the bacteria from water by use of this jelly. These filters, worked in the manner described, have been repeatedly tested; and this point has been most carefully established.

The question is now whether the bacteria are to be removed by a bacteria jelly or by an alumina jelly. There are some who think that no chemical substitute whatsoever can rightly be employed in the purification of water. It appears to me that to adopt such a sentiment is to renounce the advantages which the very elaborate study of this question has given to us. It is said that hydrate of alumina, which is one-fourth alum, is very pernicious to health. If alum ever went into the water supply, I would concede the point that it is not a proper thing to use; but it does not go into the filtered water. The alum is so perfectly decomposed that I never have been able to find it in the filtered water. The hydrate of alumina is left behind; and the alumina which goes into the water in a minute amount is also present in natural water itself. If an analysis of river water is examined, it will be found that the water contains naturally some alumina. It is the alumina in the soil which makes spring water so bright; it is the alumina in the soil which makes the water of driven wells filtered water. All that is proposed in this method is to take advantage of Nature's methods.

An "Electric Explosion" in Liverpool.—An incident, which caused the greatest consternation, and which, but for the promptitude of the police, might have been attended with much more serious consequences than it was, occurred in Liverpool on Monday afternoon of last week. It seems from the account of those who witnessed the affair that a loud explosion took place, and in a short time jets of flame were seen to spring up between the pavement near the end of Parker Street. The force of the flame gradually increased and the pavement was broken, some of the pieces being shot high into the air. The occurrence was for a time unaccountable. A police sergeant who was on duty, at once went to the scene of the fire, and came to the conclusion that it resulted from the electric wires that were laid in tubes under the pavement for electric lighting purposes. This proved to be correct. He at once communicated with the electric lighting depôt, and asked for men to disconnect the wires. In the meantime a police constable threw a quantity of sand over the flags between which the flames were issuing; and this prevented them from shooting up into the air, which they had been doing to the height of 2 or 3 feet, and appeared to be rapidly increasing in volume. As soon as the employees of the Electric Lighting Company arrived, a disconnection was made, and the flames were completely extinguished. The fire is supposed to have originated by two of the electric wires coming into contact, generating a great heat, and setting fire to the tar and rope in which the wires in the tubes are encased.

Welsh Rivers and English Water Schemes.—The Rev. O. A. Nares, Vicar of Kerry, Montgomeryshire, who recently elicited some important letters from Welsh members of Parliament on the preservation of Welsh rivers (*ante* p. 36), has published a reply to them. He says that of the four letters received on this subject, three confirm more or less his contention that the interests of Wales should be amply protected when the scheme for diverting the Elan and Claerwen to Birmingham comes before the Legislature. The argument on the export of minerals from Wales, he maintains, is not applicable to the sources of Welsh water. The latter are very few, and if lost irrecoverable; the former are practically unlimited. No one, he remarks, grudges England the full advantage of the Severn and the Wye when they leave Welsh territory; but Wales owns the *sources* of both rivers, and will insist on them and their tributaries being preserved for the benefit of Wales. No compensation for the loss of private rights over those springs will benefit Wales in the future. The letter continues: "Mr. Rendel quotes the precedent of Liverpool. Beyond the expenditure incurred by the formation of the reservoir in Wales, the county of Montgomery has secured no advantage from the water-works. The county rate is not increased in proportion to that outlay; and the floods last month caused as much damage as ever in the lower valley of the Vyrnwy. An accident to the embankment, either from insecurity or earthquake, is a constant source of danger; and if Welshmen want to drink its water, they must take it below Llanwddyn, where it becomes more or less polluted. Liverpool values that supply at three millions of pounds; and Wales may some day require to have it back at the price, and will be refused. I therefore positively assert that the diversion of the Vyrnwy has been an irretrievable national loss. The populations of English towns are so rapidly increasing, that their own natural water supplies are exhausted. They must either drink their rivers, none of which are free from impurities, or incur the serious cost of pumping water from wells. They have found what they want in the Welsh hills, and believe that Welshmen are so shortsighted as to barter their splendid advantages for a mere song, compared with the millions of pounds they are prepared to spend for the exclusive possession of the springs."

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

The Inverness Police Commission resolved last Monday to proceed with the extension of the Corporation gas-works, at a cost of about £10,000. The principal items of the extension will be the construction of a new gasholder of 380,000 cubic feet capacity, and the enlargement of the purifier plant. Thirteen years ago the storeage capacity of the works was 180,000 cubic feet. The daily output at the busiest season now averages 280,000 cubic feet; so that an extension is imperatively necessary. It is proposed to throw aside two small holders which are used up, leaving the storeage capacity at 510,000 cubic feet. The gas-works are by no means overburdened with debt. The total sum borrowed in connection with them was £40,360; and of that £7898 has been repaid—leaving £32,482 still due. Adding £10,000 to that sum, will raise the indebtedness of the Commissioners to about £42,500; which, at 4 per cent., would make an annual charge of £1690 for interest. This is surely not too much for a town like Inverness to bear; being, on an output of 40 million cubic feet a year, only something like 10d. per 1000 cubic feet—certainly no more than is paid in Edinburgh.

The Inverness Commissioners, or some of them, are still engaging in their wild-goose chase after reports which will satisfy them that the establishment of an electric lighting station would be an advisable thing. The latest which they have procured is in the form of a letter, dated Jan. 9, by Mr. F. Nell, of 16, Mark Lane, London, one of the engineers whom they are consulting. In it Mr. Nell says: "I note that the average consumption per hour (of gas), between the hours of 6 and 10 p.m., has been equal to 28,000 cubic feet, although the greatest consumption has possibly reached 37,500 cubic feet, one-eighth of the entire day's production of 300,000 cubic feet. This consumption (37,500 feet) is equal to 7500 five-feet burners, which are taken as equivalent to 16-candle lights. An equivalent number of 16-candle power incandescent lamps would require 750-horse power for generating the electricity. Therefore, the 520-horse power estimated in the report should provide two-thirds of the light required in the town." There is either a cool assumption or a palpable fallacy in this quotation. Inverness gas, as tested under the statutory condition of burning five cubic feet per hour, is of 25-candle power; and yet this "man of skill" takes a burner of that same capacity as only equal to 16 candles. He must have been judging Inverness gas by the London standard. Suppose his figures were corrected by adding the one-third to the duty of the gas which he robs it of, the horse power required to be an equivalent to it in electricity would be over 1000; and then the 520-horse power estimated in the report would only provide about one-half the light required in the town. This is probably too favourable as estimate for the electric light. Provost Ross, who should know better than I do, told the Commissioners that the proposals of the engineers would only provide light for one-seventh of the population. Another gentleman pointed out that, by abstracting water from the Caledonian Canal, they would lower the flow in the River Ness, which would lead to trouble with the proprietors of fishings. These and other considerations led the Commissioners to adopt a cautious policy; and they resolved, in the first instance, to ascertain whether the Canal Commissioners would give the necessary water.

Messrs. Hanna, Donald, and Wilson, of Paisley, have secured the contract for constructing a new gasholder at the Alloa Corporation Gas-Works, at a cost of between £5000 and £6000. Mr. Drysdale, of Glasgow, is to construct the tank.

The Dundee Police Commissioners are promoting a Police Bill in Parliament, one of the purposes of which is to give power to deal with the lighting of common stairs. At present the proprietors of properties which are entered by common stairs may be compelled to fit up gas-pipes, but not to supply gas for consumption. The Commissioners propose to retain the present powers as regards fittings, and to take powers to themselves to supply gas, at a charge not exceeding 15s. per burner per annum, to be levied from proprietors, who may recover the amount they pay from their tenants. The Commissioners would light and extinguish the lamps by their own servants.

Another gas explosion falls to be recorded, this time in Dundee; and the notable thing about it is that it occurred while the workmen of the Gas Commissioners were engaged in searching for a leak of gas. The explosion took place at two o'clock in the morning, in a two-storey house in the Lochee suburb. Eight persons were injured, two of them—an old woman who was in one of the dwellings in the tenement, and a police constable who was standing outside—rather severely. The workmen were at the time digging for the service-pipe, and were using a safety-lamp. It is supposed that the explosion was caused by a lamp inside the building.

Mr. Andrew Ross, late of the Paisley Gas-Works, who was appointed Manager of the Tain Gas-Works in the beginning of December, has already tendered his resignation. The reason for this step is not stated; but there must have been something very disappointing in the service when Mr. Ross could only hold the post for a month or so. The Gas Commissioners have resolved to fill up the vacancy from the list of candidates from among whom Mr. Ross was selected.

At the last meeting of the Hamilton Town Council, there was submitted a report which had been prepared by Mr. Gillespie, late of the Barrowfield Iron-Works, regarding the proposed extension of the gas-works. It had already been discussed by the Gas Committee; and they had agreed to delay further consideration of it. The Committee had also resolved to have inquiries instituted as to the practicability of introducing electric lighting into the town as a municipal concern, and as to the method and machinery by which it could be introduced. The Manager's report showed that the cost of making gas last month was 1s. 3⅞d. per 1000 cubic feet; and the average illuminating power, 27·7 standard candles. Provost Archibald moved the adoption of the minutes of the Gas Committee. Ex-Bailie Tainsh, a former Convener of the Gas Committee, inquired if any better quality of coal was being supplied at the gas-works; and, in reply, the Provost said he understood that the coal in use was very much the same as had been used for a number of years. Mr. Tainsh would have it, however, that the quality was very inferior; but if that were so, how could inferior coal, in ordinary working, possibly give gas of such a high average illuminating power as 27·7 standard candles? Mr. Tainsh's complaints seemed to excite practically very little interest amongst his colleagues, for the report of the Committee was adopted without any division being taken.

The placing of the Glasgow gasholder with the Glasgow firm rather than with the Paisley firm, has not given universal satisfaction outside any more than inside the Town Council. The "outside" objection find a spokesman in the shape of an embryo Town Councillor, who states the case for them in one of the daily papers. He says: "By all fair means keep the city work to city ratepayers, so long as it can be done as well and as cheap, but such citizens must at the same time be made to feel that no preference should be expected; and, if any, it should rather be in favour of the Corporation, the work costing less to such a contractor than to the stranger or outsider." He goes on to say: "The 'time' clause was, in my opinion, of no real moment, and not in the essence of such a contract, for were the quality of Glasgow gas as it ought to be, the present gasholder accommodation is ample for many years to come. The increased storeage clamoured for is to accommodate the additional bulk of low illuminating power gas, and which the public may blame itself for tolerating. The successful offerer can give more guarantee for the fulfilment of the contract than the other, who was £1200 lower; and, as previous jobs have proved, the firm is quite as capable and more likely to complete the work than the other." He finishes up by saying: "The question of a member of Council sitting upon a Committee having the power to give the contract to the firm of which he is said to be a partner, and a relative of the principals, and to which firm he is likely to supply the iron and steel required in the job, is surely, altogether too transparent to find justification." To me it seems that the authorship of this plain-spoken letter of complaint could be traced home to a local gentleman who has been long and intimately identified with the gas industry; and that is partly my excuse for giving it prominence in the JOURNAL. It would have been more satisfactory, however, if the writer had attached his name to the letter.

The Town Council of Paisley held an ordinary meeting as the Gas Commissioners on Tuesday evening; and in the course of the proceedings, ex-Provost Cochran raised a question as to the disposal of the gas surplus of the last financial year, which amounted to £8000. His opinion was that a sum of £4000 should go towards the reduction of the money borrowed, and the other £4000 towards the improving of the town. He thought that they should there and then come to an agreement as to what they should do with the gas surplus. The old Provost is a keen supporter of the policy of making town improvements out of gas profits; and he would keep up the price of gas unnecessarily high, so as to be able to get a haul out of the surplus every year for that purpose. The Convener of the Gas Committee (Councillor M'Farlane), who believes in the common-sense policy of having "every herring to hang by its own tail," explained that it had been agreed by the Council to hold the matter over for a time. But that explanation did not satisfy the ex-Provost, who forthwith gave notice of motion that at the next meeting of the Council they dispose of the gas surplus for two objects—to reduce the debt on the money borrowed, and to apply a part of it to the improvement of the town. It is confidently anticipated that he will get the support of the present Provost (Mr. MGown), who was long a Convener of the Gas Committee, and who agrees with Provost Cochran in depending to some extent on the surplus gas profits for the improvement of the town.

The Glasgow pig-iron market has again been very idle this week; but a few lots of Scotch iron have changed hands at 47s. per ton cash, at which there are still buyers. In hematite and Cleveland warrants, a little business has been done at between 47s. 10½d. and 47s. 6½d. per ton for the former, and between 38s. 2d. and 38s. per ton cash for the latter; the closing quotations being, respectively, 47s. 7d. and 38s. 0½d. per ton cash. There are now 76 blast-furnaces in actual operation—48 making ordinary iron, 22 working on hematite ore, and 6 making basic iron. At this time last year only 6 furnaces were blowing.

Water Supply and Electric Lighting at St. Helens.—General C. Phipps Carey, R.E., one of the Local Government Board Inspectors, held an inquiry yesterday week at St. Helens, into an application by the Town Council for sanction to borrow £2100 for works of water supply (principally for additional water-mains), and £1700 for the electric lighting and ventilating of the Town Hall. The case for the Corporation was presented by the Town Clerk (Mr. J. Jeeves); and there was no opposition.

The Managership of the Colne Gas-Works.—In the JOURNAL last week a paragraph appeared on the above subject, in which it was stated that Mr. G. Dyson, a member of the Colne Local Board, had been appointed Manager of the gas-works. The statement was given on the authority of one of our correspondents; but we received a telegram yesterday afternoon (too late for inquiries to be made into the matter) from Mr. H. Simmonds, the Manager, to the effect that the reported change is without foundation, and asking us to make the necessary correction.

The Dangers of Fire-Plugs.—In the Queen's Bench Division of the High Court of Justice last Wednesday, an action was brought by a Mr. Magney and his wife, against the East London Water-Works Company, to recover compensation for injuries suffered in consequence of a street accident caused, as they alleged, by the Company's negligence. The plaintiffs were dealers in crockery ware and in coals, and on the night of Sunday, Jan. 25 last year, they were driving along Mercer Street, Cable Street, E., when the pony put its foot into a water-plug hole and fell. Mr. Magney was thrown on to the road, his wife on to the front of the cart; and both were a good deal hurt. The pony was permanently lamed. The case for the plaintiffs was that there was want of care on the part of the Company in leaving the plug-hole uncovered. On the other side, it was said that the Company had affixed firmly a proper cover to the hole, and that some person had wrongfully interfered with it, or it had become damaged by frost. The jury heard evidence on both sides; and, in the end, they gave a verdict for the defendants.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Jan.* 16.

Sulphate of Ammonia.—The demand has been good; and the market is advancing steadily. It may be taken as a healthy symptom, and a proof of the soundness of the position, that there is no spurt, nor yet any excitement; and all purchases seem to be made simply to supply pressing requirements. It is quite evident now that the bulk of the consumers have been waiting for an illusory cheaper market, and they have come on the market with a fairly good grace, and, of course, prices are still low. The quotations were close on £11 towards the end of January last year; they were quite £12 at the same period in 1890; and at £12 10s. in January, 1889. Both France and Germany are operating, paying present full values. But Spain has been especially active; and a large quantity has been sold to that country. As some of the buyers have secured their most urgent requirements, spot parcels are perhaps not now quite so eagerly competed for. There is, however, comparatively so little offering, that a relapse cannot be thought of; while a continuance of the demand will have the effect of gradually pushing up prices further. The advance will, however, be in a measure regulated by the state of the weather—*i.e.*, its severity or a return to a milder temperature. To-day's figures are £10 10s. to £10 12s. 6d.; and about 5s. per ton advance quoted for Feb.-April delivery. The nitrate market is firmer. The lowest price now is 9s. 4½d. per cwt.; and there is a good demand.

LONDON, *Jan.* 16.

Tar Products.—A somewhat better feeling obtains in the markets. Buyers have at last made up their minds that benzol is worth buying at to-day's price. Pitch, too, is in good request; but 3s. to 5s. per ton less is offered for next season's delivery. Solvent naphtha also is better; and forward business is being booked at 2d. above the price quoted below. Creosote, common oils, carbolic acid, anthracene, and naphthalene are all weak and unsaleable. Business has been done at the following prices: Tar, 20s. Pitch, 33s. 9d. Benzol, 90's., 2s. 2d.; 50's., 1s. 8½d. Toluol, 1s. 3d. Solvent naphtha, 1s. 1½d. Crude benzol naphtha, 30 per cent., 10d. Creosote, ½d. to 1d. Crude naphthalene, 35s. Crude carbolic, 60's, 1s. 1d.; crystals, 5d. Cresol, 8½d. Anthracene (nominal), "A" quality, 1s. 1d.; "B," 9d.

Sulphate of Ammonia.—This market is also stronger; and there is a good deal of inquiry for early spring delivery. Large sales have taken place, at prices ranging from £10 10s. to £10 15s., less 3½ per cent. Gas liquor (10 oz.) is quoted at 6s. 6d. to 8s. per ton, according to position.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—There is no specially new feature to notice with regard to the coal trade of this district. The better qualities, suitable for house-fire purposes, continue in active demand at full rates, with temporarily a scarcity of supplies owing to the recent stoppages of the pits; but the lower qualities, for iron making, steam, and general manufacturing purposes, continue only in moderate request, with supplies plentiful and prices barely maintained. At the pit mouth, best Wigan Arley coals average 12s. 6d.; Pemberton four-feet and second qualities of Arley, 10s. 6d. to 11s.; common house-fire coals, 9s. to 9s. 6d.; and steam and forge coals, 8s. to 8s. 6d. For shipment, there has been a fair demand with good qualities of steam coals delivered at the ports on the Mersey at about 9s. 9d. to 10s. per ton. The chief item of interest is a decided improvement as regards engine-fuel, supplies of which have been moving off much more freely; and with an absence of the recent competition with cheap surplus quantities, rather better figures have been obtainable in many cases—medium sorts showing an advance of about 3d. per ton upon recent quotations. At the pit mouth, burgy averages 6s. to 6s. 6d. for ordinary qualities, to 7s. for special sorts; best slack, 5s. to 5s. 6d.; medium qualities, 4s. 3d. to 4s. 9d.; and common sorts, about 3s. to 3s. 6d. per ton.

Northern Coal Trade.—There has been in the last few days more activity in the coal trade of the North; and with a fuller production, a better trade has been done. Best Northumbrian steam coal has been very freely sold at prices that vary from 10s. to 10s. 6d. per ton, f.o.b. Second qualities are scarcely so steady, at about a shilling per ton less; and small steam coal is also weaker, at from 3s. 6d. to 5s. per ton, according to quality. For best Durham gas coals there is a very large local demand; and the cold weather has kept the consumption of that class of coal above even the usually heavy requirements of this season. The price varies from 9s. to 9s. 6d., though there have been sales below the former price. Very heavy shipments of gas coals are being made to London just now, and also to some of the Mediterranean ports. Bunker coals are quiet; but the prices vary very much—from 8s. 6d. per ton upwards, the best Durham screened being 12s. per ton. Manufacturing coal is quiet, at rather lower prices. In coke, best blast-furnace kinds are firmer, and have been sold at higher prices, though the general quotation is 16s. 6d. per ton, f.o.b. For gas coke, the abundant supply is forcing down prices; and contracts as low as 8s per ton are now spoken of.

West of Scotland.—The coal trade in the West of Scotland continues quiet, and some difficulty has been experienced in obtaining supplies of coals for the loading of vessels now in harbour. There has been a spurt in the demand for household coal, in consequence of the severe weather; and prices are firm. For prompt delivery, buyers are conceding late rates; but there has been no forward business done as yet. Both foreigners and dealers are holding off, to see what effect the troubles in Fife may have; while the reduction in price there and in several parts of England may, it is also thought, influence the course of trade in the Glasgow district. The following are the prices at Glasgow Harbour: Splint, 9s. 3d. to 9s. 6d. per ton; main coal, 8s.; steam, 10s. to 10s. 6d.; ell, 8s. 9d. to 9s.—all f.o.b.

Electric Lighting for Chester.—The Chester Town Council last Wednesday adopted a recommendation of the Watch Committee, that a sum not exceeding £20,000 be voted for providing a first installation of the electric light for the borough.

Additional Storeage Accommodation at the Carlisle Gas-Works.—In consequence of the increase in the consumption of gas at Carlisle, the Engineer of the Corporation Gas-Works (Mr. J. Hepworth) has received instructions from the Gas Committee to prepare plans and specifications for the extension of the No. 4 gasholder.

Suggested Purchase of the Sevenoaks Water-Works by the Local Board.—At a recent meeting, the Sevenoaks Local Board resolved to oppose the Provisional Order which the Water Company are making application for to the Board of Trade; and the Clerk was also instructed to write to the Company and ask whether they are prepared to sell their property.

Stroud Water Company.—An extraordinary meeting of this Company was held last Tuesday, at 11, Queen Victoria Street, E.C., for the purpose of authorizing the issue of a further £10,000 of 4½ per cent. debentures. Mr. Owen F. Jones, who presided, in explaining the object of the meeting, said that the sum would be raised in debentures of £100 each, bearing interest at not more than 4½ per cent. The whole amount would not be issued at once; but only such proportions as might be necessary to pay off the balance of existing Lloyd's bonds and other liabilities of the Company. They now owed upon Lloyd's bonds between £6000 and £7000. He proposed a resolution sanctioning the issue of the debentures; and this was unanimously agreed to.

The Hartley Reservoir of the Plymouth Corporation.—According to a statement presented by the Borough Treasurer at the meeting of the Plymouth Borough Council last Wednesday, the Hartley water reservoir has been an expensive piece of work. It appears that in 1859, £1814 was spent on land for the reservoir; and between that year and 1862, a sum of £7908 was expended in constructing it. Two years later, it cost £1166 in trying to stop a leakage. In 1882, an outlay of £3015 was incurred in reconstructing the reservoir; and last year the eastern wall was repaired at a cost of £402. These various items amount to £14,305. At the meeting on Wednesday, the Water Committee submitted a report, recommending that the northern wall be now re-erected at an estimated cost of £1700; but the report was referred back to them, with instructions to inquire into the works necessary to put the reservoir into a thoroughly satisfactory condition.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 104.)

Issue.	Share	When ex-Dividend.	Dividend or Int. & Bonus.	NAME	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	15 Oct.	10½	Alliance & Dublin 10 p. c.	10	16—17	..	6 3 6
100,000	10	"	7½	Do. 7 p.c	10	11½—12½	..	6 0 0
300,000	100	2 Jan.	5	Australian (Sydney) 5 % Deb.	100	105—107	..	4 13 5
100,000	20	27 Nov.	8	Bahia, Limited	20	12—14	..	11 8 6
200,000	5	12 Nov.	7½	Bombay, Limited	5	6½—7	..	5 7 1
40,000	5	"	7½	Do. New	4	4¾—5¼	..	5 14 1
380,000	Stck.	13 Aug.	12½	Brentford Consolidated	100	210—220	..	5 11 4
125,000	"	"	9½	Do. New	100	157—162	..	5 14 2
220,000	20	16 Sept	11½	Brighton & Hove Original	20	40—42	..	5 9 6
888,500	Stck.	16 Sept.	5	Bristol	100	98—103	..	4 17 1
320,000	20	15 Oct.	11½	British	20	42—44	..	5 2 3
50,000	10	28 Aug.	11½	Bromley, Ordinary 10 p. c.	10	18—20	..	5 15 0
50,380	10	"	8½	Do. 7 p. c.	10	13—15	..	5 13 4
328,750	10	—	—	Buenos Ayres (New) Limited	10	5½—6½	..	—
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	100	90—95	..	6 6 4
150,000	20	13 Aug.	8	Cagliari, Limited	20	24—26	..	6 3 1
550,000	Stck.	15 Oct.	13½	Commercial, Old Stock	100	240—250	..	5 10 0
165,000	"	"	10½	Do. New do.	100	190—195	+2½	5 10 3
130,000	"	30 Dec.	4½	Do. 4½ p. c. Deb. do.	100	117—122	..	3 13 9
800,000	Stck.	30 Dec.	13	Continental Union, Limited	100	225—235	+5	5 10 8
200,000	"	"	10	Do. 7 p. c. Pref	100	185—195	..	5 2 7
75,000	Stck.	16 Sept.	10	Crystal Palace District	100	190—200	..	5 0 0
486,090	10	15 July	10	European, Limited	10	19—20	..	5 0 0
354,060	10	"	10	Do. Partly paid	7½	14—15	..	5 0 0
5,470,640	Stck.	13 Aug.	13	Gaslight & Coke, A, Ordinary	100	218—223	—4½	5 16 7
100,000	"	"	4	Do. B, 4 p. c. max.	100	95—98	+1	4 1 7
665,000	"	"	10	Do. C, D, & E, 10 p.c. Pf.	100	248—253	..	3 19 1
30,000	"	"	5	Do. F, 5 p. c. Prf.	100	118—123	..	4 1 4
60,000	"	"	7½	Do. G, 7½ p. c. do.	100	172—177	..	4 4 9
1,300,000	"	"	7	Do. H, 7 p. c. max	100	152—157	—1	4 9 2
463,000	"	"	10	Do. J, 10 p. c. Prf.	100	245—250	..	4 0 0
476,000	"	"	—	Do. K, 6 p. c. Prf.	100	145—150	..	4 0 0
1,061,150	"	11 Dec.	4	Do. 4 p. c. Deb. Stk.	100	110—114	..	3 10 2
294,850	"	"	4½	Do. 4½ p. c. do.	100	118—123	..	3 13 2
908,000	"	"	6	Do. 6 p. c. do	100	160—165	..	3 12 9
3,800,000	Stck.	12 Nov.	12	Imperial Continental	100	224—229	+3	5 4 9
75,000	5	26 June	6	Malta & Mediterranean, Ltd.	5	4—4½	..	6 13 4
560,000	100	1 Oct.	5	Met. of Melbourne, 5 p. c. Deb.	100	109—111	..	4 10 1
541,920	20	27 Nov.	6½	Monte Video, Limited	20	15—16	..	8 2 6
150,000	5	27 Nov.	10	Oriental, Limited	5	8½—9	..	5 11 1
60,000	5	30 Sept.	7	Ottoman, Limited	5	4—5	..	7 0 0
166,870	10	26 Feb.	2	Para Limited	10	2½—3½	..	—
420,000	100	3 Nov.	6	People's Gas of Chicago—1st Mtg. Bds.	100	94—99	..	6 1 3
500,000	100	1 Dec.	6	2nd Do.	100	93—98	..	6 2 5
150,000	10	15 Oct.	10	San Paulo, Limited	10	10—12	—½	8 6 8
500,000	Stck.	28 Aug.	15½	South Metropolitan, A Stock	100	265—275	..	5 12 9
1,350,000	"	"	12	Do. B do.	100	222—227	..	5 5 8
200,000	"	"	13	Do. C do.	100	225—235	..	5 10 8
700,000	"	30 Dec.	5	Do. 5 p. c. Deb. Stk.	100	138—143	..	3 10 0
600,000	Stck.	16 Sept.	11½	Tottenham & Edm'nton, Orig.	100	—	..	—
				WATER COMPANIES.				
729,331	Stck.	30 Dec.	10	Chelsea, Ordinary	100	260—265	+2½	3 15 6
1,720,560	Stck.	15 Oct.	8	East London, Ordinary	100	206—211	+2	3 15 11
544,440	"	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	100	136—140	..	3 4 3
700,000	50	11 Dec.	8	Grand Junction	50	99—104	+1	3 16 11
708,000	Stck.	13 Aug	10½	Kent	100	270—275	..	3 16 4
1,043,800	100	30 Dec.	9½	Lambeth, 10 p. c. max.	100	225—235	+5	4 0 10
406,200	100	"	7½	Do. 7½ p. c. max.	100	189—194	..	3 17 4
260,000	Stck.	30 Sept.	4	Do. 4 p. c. Deb. Stk.	100	120—123	..	3 5 0
500,000	100	13 Aug.	12½	New River, New Shares	100	335—345	..	3 20 4
1,000,000	Stck.	30 July	4	Do. 4 p. c. Deb. Stk	100	125—127	..	3 3 0
902,300	Stck.	30 Dec.	6½	S'thwk & V'xhall, 10 p. c. max.	100	149—154	..	4 4 5
126,500	100	"	6½	Do. D 7½ p. c. do.	100	140—145	..	4 9 8
1,155,666	Stck.	11 Dec.	10	West Middlesex	100	245—255	..	3 18 5

Messrs. C. Wilson and Sons, of Leeds, have opened show-rooms for their various types of gas cooking-stoves and other appliances at No. 76, Queen Victoria Street, E.C., and at No. 32 Rue de Bondy, Paris.

Advance of Gas Workers' Wages at Hull.—As the result of demands put forward by the workmen employed by the British Gaslight Company at Hull, the Directors have made certain concessions in regard to their remuneration. The wages of the cinder men are advanced from 4s. 4d. to 4s. 8d. per shift of eight hours, and the men are to be paid time-and-a-half instead of time-and-a-quarter for Sunday work, double time for Christmas Day (instead of a gratuity of 2s. 6d. being given to each man), also for Good Friday and two former holidays granted to men who had been twelve months in the Company's service. In lieu of these two holidays, the men will be paid for Whit Monday and the August Bank Holiday; in other words, they will get four holidays instead of two, and be paid single time if not at work those days. These are the Leeds terms; and at a meeting held by the men last Wednesday, the Directors and the Manager (Mr. A. Dougall) were thanked for the courteous manner in which their application had been received and dealt with.

The Artesian Well in the City.—At the meeting of the Commissioners of Sewers last Tuesday, the Engineer (Mr. W. Haywood) presented a report on the works which had been carried on at the artesian well since the last meeting. It set forth that, when the depth of 512 feet had been arrived at, the character of the chalk changed; and he ordered the boring to be stopped at a depth of 513 feet. By means of the present pumps, 70,000 gallons of water daily could be raised, which was more than three times the quantity required for the artizans' dwellings. He thought the well was capable of raising 100,000 gallons in 24 hours. He further recommended that, in order to serve the artizans' dwellings, pumps and a gas-engine should be set up, and pipes laid down; and he estimated that the total cost of supplying 20 gallons of water per head per day would be £1690, which did not include the cost of a duplicate engine. The present cost of the supply from the New River was £80 a year; but the new supply would cost about £150 a year, not including depreciation of machinery. Mr. Pannell asked if the surplus supply could be dealt with in any way. The Solicitor said they could do nothing but give the water away. The Commissioners had no power to break up streets for the purpose of supplying water or to invest the ratepayers' money in lead pipes, &c. Mr. Morton asked how it was that the Commissioners could lay water-pipes and break up the streets for the citizens. The Solicitor said it was done under the Commissioners' own Act of Parliament for lighting and cleansing the streets. Mr. Wallace then moved that the report should be referred to the Streets Committee; and this was adopted. It was also agreed to give the Engineer instructions to complete the well in all particulars.

The Coal Production of the United States Last Year.—The production of anthracite coal in the United States last year amounted to 42,839,779 tons; while that of bituminous coal was 98,000,000 tons—being both considerably larger than in 1890.

Petroleum and Gas in France.—At the present time, the members of both the Chamber of Deputies and the Senate in Paris are displaying great anxiety to prohibit the importation of refined petroleum into France. Although, according to the Paris correspondent of the *Daily News*, this is ostensibly due to a desire to protect French refineries, it is really in the interest of shareholders in the Paris and provincial gas companies. "If," says that authority, "petroleum were as cheap in France as it is in England, gas shares would come down with a jump from their present high prices to fairly moderate ones." While 9d. per gallon is the charge for petroleum in England, in Paris it is no less than 8d. per quart.

The Gas Supply of Middlesbrough.—In moving the adoption of the minutes of the Gas Committee at the meeting of the Middlesbrough County Council last Tuesday, Alderman Bell referred to complaints which had been made as to the defective supply of gas in the borough. He said that, from a report which their Engineer (Mr. D. Terrace) had made on the subject, it did not seem to him possible to demonstrate that the defective lighting was attributable to any change in the conditions at the gas-works; and the gas, so far as he had been able to judge, was as good as it had ever been. He was not prepared to assert that the pressure all over the town was as satisfactory as it might be—indeed, he was perfectly ready to admit that the Gas Committee, in view of the many changes contemplated, had not kept pace with the growth of the town, and that in some districts there was hardly so great a volume of gas as would satisfy the wants of the consumers. The Council were, however, asked that day to sanction the laying of a new main from the gasholder on the Marshes, which would, he hoped, give a much more adequate volume of gas to the south part of the town, and would thereby relieve the whole of the other mains. In the course of a short discussion on the subject, Alderman Bulmer expressed the opinion that they had never had better gas than at present; and great credit was due to Mr. Terrace, for they had been able to lay off 25 beds of retorts, and had still supplied the wants of the town. During the past year they had sold 1,500,000 cubic feet of gas more than in the previous year; and they had actually obtained 500 cubic feet of gas out of every ton of coal beyond what they did in the preceding year. Alderman Bell further remarked that the make of gas had increased during the year by 5 per cent., which was quite in proportion with the growth of the borough. He undertook that no endeavour should be wanting to give a satisfactory supply throughout the town. The minutes, including that authorizing the laying of the new main, were then confirmed.

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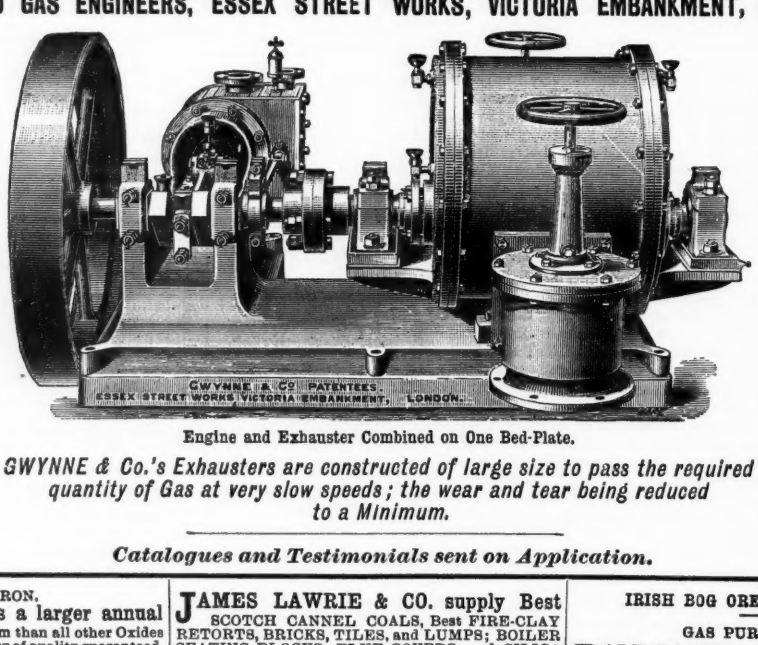

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Also GIRARD and other TURBINES, HIGH-SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.

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*** See Advertisement p. 128 of this week's issue.
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Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

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WANTED, by a Practical Working Manager (who has had over 20 years' practical experience, at home and abroad, in the Management of Gas and Water Works), the SOLE CHARGE and MANAGEMENT of a Gas-Works, where the annual make is from 8 to 12 millions. Good testimonials and references. Speaks French. No objection to going abroad. Age 40 years. Married.
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Address, stating age, experience, married or otherwise, and salary required, No. 2059, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

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WANTED, at the Reading Gas-Works, a thoroughly experienced DRAUGHTSMAN conversant in the construction of modern Gas-Works.
Apply, enclosing testimonials or references, and stating experience, salary required, age, &c., to Mr. EDWARD BAKER, Engineer and Manager.

BOROUGH OF ROTHERHAM.

THE Corporation require the Services of a GAS ENGINEER to manage the Gas and Water Undertakings.
Salary, £300 per annum.
Applications, with testimonials, to be sent to me on or before Thursday, the 28th inst. at noon.
By order.
H. H. HICKMOTT, Town Clerk.
Council Hall, Rotherham, Jan. 12, 1892.

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
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WANTED, by the Directors of the above Company, a competent man as MANAGER and ENGINEER. The person appointed must devote his whole time to the duties of the office. Salary £100 per annum, with free House, Rates, Coal, and Gas.
Applications, stating age, qualifications, and previous employment, with not more than three testimonials of recent date, to be sent to me not later than the 26th of January, 1892.
J. T. BOWNASS, Solicitor.
Windermere.

COLNE AND MARSDEN LOCAL BOARD.

THE Gas Committee invite Tenders for the supply and erection of an ANNULAR CONDENSER complete, with 14-inch Connections and Bye-Pass Valves, capable of passing 90,000 cubic feet per hour.
Tenders, with tracing enclosed, showing the general arrangement of the Condenser, to be sent to me on or before the 21st day of January.
HY. SIMMONDS, Engineer and Manager.
Gas-Works, Colne, Jan. 8, 1892.

THE Directors of the Eccleshill and Bolton Gas Company are prepared to receive separate TENDERS for the construction and erection of a SINGLE and a TWO-LIFT GASHOLDER, 77 feet diameter.
The Drawings and Specification may be inspected on application to J. Lee, Gas-Works, Eccleshill.
Sealed tenders, endorsed "Gasholder," and addressed to Wm. Smith, Esq., Chairman, are to be delivered on or before Twelve o'clock noon, on Thursday, the 28th day of January next.
The Directors do not bind themselves to accept the lowest or any tender.
J. LEE, Engineer.
Gas-Works, Eccleshill, Jan. 14, 1892.

MESSRS. DEBENHAM, TEWSON FARMER, and BRIDGEWATER'S MONTHLY LIST of Shops, Show-Rooms, Factories, and Wateraide Premises, suitable for the Exhibition and Manufacture of Engineering and other Appliances, may be obtained, free of charge, at their Offices, 80, CHEAPSIDE, E.C.

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Inquiries should be addressed to THE AUTOMATIC COAL-GAS RETORT COMPANY, LIMITED, 86-88A, LEADENHALL STREET, E.C.

THE Directors of the Ashford Gas and Coke Company, Limited, desire TENDERS for providing and fixing a WROUGHT-IRON ROOF for a Brick Building, 83 feet long by 36 feet wide.
The Plan may be seen at the Gas-Works, and particulars obtained of Mr. J. Morton, the Manager.
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F. HUGHES-HALLETT, Secretary.

CONTRACT No. 1.

THE Imperial Ottoman Government are prepared to receive TENDERS for the supply and delivery, free in Harbour, Constantinople, of one set of WROUGHT-IRON ANNULAR CONDENSERS. 32 ft. 8 in. high by 8 ft. diameter, together with all necessary Valves, Connections, &c., and one WROUGHT-IRON FOUL MAIN, 18 inches diameter, together with the necessary Wall-Brackets, Plates, Bends, &c.
Drawing and copy of Specification may be had upon application to His Excellency Yeikie Pasha, Grand Master of Artillery, Constantinople.
Sealed offers, endorsed "Tender for Condensers," to be addressed to His Excellency the Grand Master of Artillery, Constantinople.
The Government do not bind themselves to accept the lowest or any tender.
By order.

CONTRACT No. 2.

THE Imperial Ottoman Government are prepared to receive TENDERS for the supply and delivery, free in Harbour, Constantinople, of one TWO-LIFT TELESCOPIC GASHOLDER, 100 ft. diameter and 40 ft. deep, in two Lifts, 20 ft. deep each Lift.
Also for a CAST-IRON TANK, 103 ft. 6 in. diameter by 20 feet deep, together with 18-inch Inlet and Outlet Valves, Stand-Pipes, and Connections.
Drawing and copy of Specification may be had upon application to His Excellency Yeikie Pasha, Grand Master of Artillery, Constantinople.
Sealed tenders, endorsed "Tender for Gasholder and Tank," to be addressed to His Excellency the Grand Master of Artillery, Constantinople.
The Government do not bind themselves to accept the lowest or any tender.
By order.

CONTRACT No. 3.

THE Imperial Ottoman Government are prepared to receive TENDERS for the supply and erection ready for work of 64 BRICK-BUILT RETORTS, 22 in. by 16 in., ∩ shape, set in Four through Arches, 20 feet long, fired on the Regenerator System.
Also for MOUTHPIECES, with Self-Sealing Lids, Ascension, Bridge, and Dip Pipes, Hydraulic Main, Seal-Valves for Hydraulic Main, &c.
Copy of specification may be had upon application to His Excellency Yeikie Pasha, Grand Master of Artillery, Constantinople, to whom tracing of proposed setting must be sent.
Sealed tenders, endorsed "Tender for Retorts and Ironwork," to be addressed to His Excellency the Grand Master of Artillery, Constantinople.
The Government do not bind themselves to accept the lowest or any tender.
By order.

CONTRACT No. 4.

THE Imperial Ottoman Government are prepared to receive TENDERS for the supply and delivery, free in Harbour, Constantinople, of One STATION METER, in square case, to pass 40,000 cubic feet per hour, together with Inlet, Outlet, and Bye-Pass Valves, Connections, &c.
Copy of Specification may be had upon application to His Excellency Yeikie Pasha, Grand Master of Artillery, Constantinople.
Sealed tenders, endorsed "Tender for Station Meter," to be addressed to His Excellency the Grand Master of Artillery, Constantinople.
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Specifications and Forms of Tender may be obtained from Mr. Carr, Gas-Works, Widnes.

Tenders, endorsed "Fire-Clay Goods," to be addressed to the Chairman of the Gas Committee, and delivered to the undersigned not later than noon on the 1st of February prox.

The Board do not bind themselves to accept the lowest or any tender.

H. S. OPPENHEIM,
Clerk.

Town Hall, Widnes,
Jan. 16, 1892.

BOROUGH OF WEST BROMWICH.

(GAS DEPARTMENT.)

THE Gas Committee are prepared to receive TENDERS for the construction of a BRICK GASHOLDER TANK, 124 feet diameter, at their Gas-Works, Albion, West Bromwich.

Drawings and Specifications may be seen, and all information obtained, upon application to the Manager (Mr. Littlewood), at the Works, as above.

Tenders, properly endorsed, to be sent to me at the Town Hall, West Bromwich, not later than the 28th inst.

The Gas Committee do not bind themselves to accept the lowest or any tender.

By order,
THOS. HUDSON,
Secretary.

Town Hall, West Bromwich.
Jan. 9, 1892.

SHEFFIELD UNITED GASLIGHT COMPANY.

GRIMESTHORPE STATION.
CONTRACT No. 4.
TO IRONFOUNDERS.

THE Directors of this Company invite TENDERS for the supply of CAST-IRON STANDARDS and other IRONWORK required for a Framing in the No. 1 Gasholder Tank at their Grimesthorpe Station.

Bill of Quantities may be obtained, and the Drawings may be seen at the Company's Offices upon application to the Engineer, Mr. Fletcher W. Stevenson.

The Directors do not bind themselves to accept the lowest or any tender.

Sealed tenders, marked "Tender for Ironwork for Tank Framing," and addressed to the undersigned, must be delivered at the Company's Offices, by post, not later than Saturday, Jan. 30, 1892.

HANBURY THOMAS,
General Manager.

Commercial Street, Sheffield,
Jan. 9, 1892.

SHEFFIELD UNITED GASLIGHT COMPANY.

GRIMESTHORPE STATION.
CONTRACT No. 5.
TO JOINERS AND GENERAL BUILDERS.

THE Directors of this Company invite TENDERS for the construction of a TIMBER FRAMING in the No. 1 Gasholder Tank, at their Grimesthorpe Station.

Bill of quantities may be obtained, and the Drawings may be seen, at the Company's Offices, upon application to the Engineer, Mr. Fletcher W. Stevenson.

The Directors do not bind themselves to accept the lowest or any tender.

Sealed Tenders, marked "Tender for Timber Framing for Gasholder Tank," and addressed to the undersigned, must be delivered at the Company's Offices, by post, not later than Saturday, Jan. 30, 1892.

HANBURY THOMAS,
General Manager.

Commercial Street, Sheffield,
Jan. 9, 1892.

PENRITH LOCAL BOARD.

THE Gas Committee of the Penrith Local Board are prepared to receive TENDERS for the construction and erection of a GASHOLDER and TANK and other APPARATUS at the Gas-Works, Penrith.

Plans and Specifications may be seen at the Offices of the Local Board, or on application to Mr. J. Hepworth, C.E., Gas-Works, Carlisle.

Tenders, endorsed "Tender for Extensions," must be delivered to me not later than the 8th day of February, 1892.

The lowest or any tender will not necessarily be accepted.

By order,
GEO. WAINWRIGHT,
Clerk to the Board.

Public Offices, Penrith,
Jan. 15, 1892.

COUNTY BOROUGH OF SALFORD.

(GAS DEPARTMENT.)

RETORTS AND FIRE-BRICKS.

THE Gas Committee invite Tenders for the supply of RETORTS and FIRE-BRICKS required at their various Works.

Full particulars and Form of Tender may be obtained on application to the Gas Engineer, Gas Offices, Bloom Street, Salford.

Sealed tenders, endorsed "Fire-Clay Goods," addressed to the Chairman of the Gas Committee, to be sent to my Office, not later than Five p.m., on Thursday, the 4th of February next.

By order,
SAML. BROWN,
Town Clerk.

Town Hall, Salford,
Jan. 16, 1892.

COUNTY BOROUGH OF BURNLEY.

THE Gas Committee of the Corporation of Burnley are prepared to receive TENDERS for the supply and erection at their Gas-Works of the following:—

1. One Complete set of CONDENSERS, capable of dealing efficiently with a make of 3,000,000 cubic feet of Gas per day.
2. Two EXHAUSTERS, with Engines, each to pass 75,000 cubic feet of Gas per hour, complete with Inlet and Outlet Valves, self-acting Bye-pass, and Compensating Governor.

Further information may be obtained from Mr. J. P. Leather, Gas Engineer, Gas-Works, Burnley.

The Corporation do not bind themselves to accept the lowest or any tender.

Tenders, endorsed "Condensers" or "Exhausters," as the case may be, to be sent in, addressed to the Chairman of the Gas Committee, Town Clerk's Office, Burnley, not later than Wednesday, the 27th of January, 1892.

By order,
ROBERT E. FOX,
Town Clerk.

Town Hall, Burnley,
Jan. 16, 1892.

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CONSPIRACY and Protection of Property Act. It is required, under a Penalty of FIVE POUNDS, that a Printed Copy of the 4th Section of this Act shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by the persons employed thereat.

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GEO. NICHOLS, SON, & ALDER are instructed to SELL by PUBLIC AUCTION, at their SALE-ROOM, 49, BROAD STREET, Bristol, on Wednesday, the 17th day of February, 1892, at 2.30 p.m. precisely, IN LOTS OF £100 EACH,

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NEW DEBENTURE STOCK
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JAMES VINCENT GREEN,
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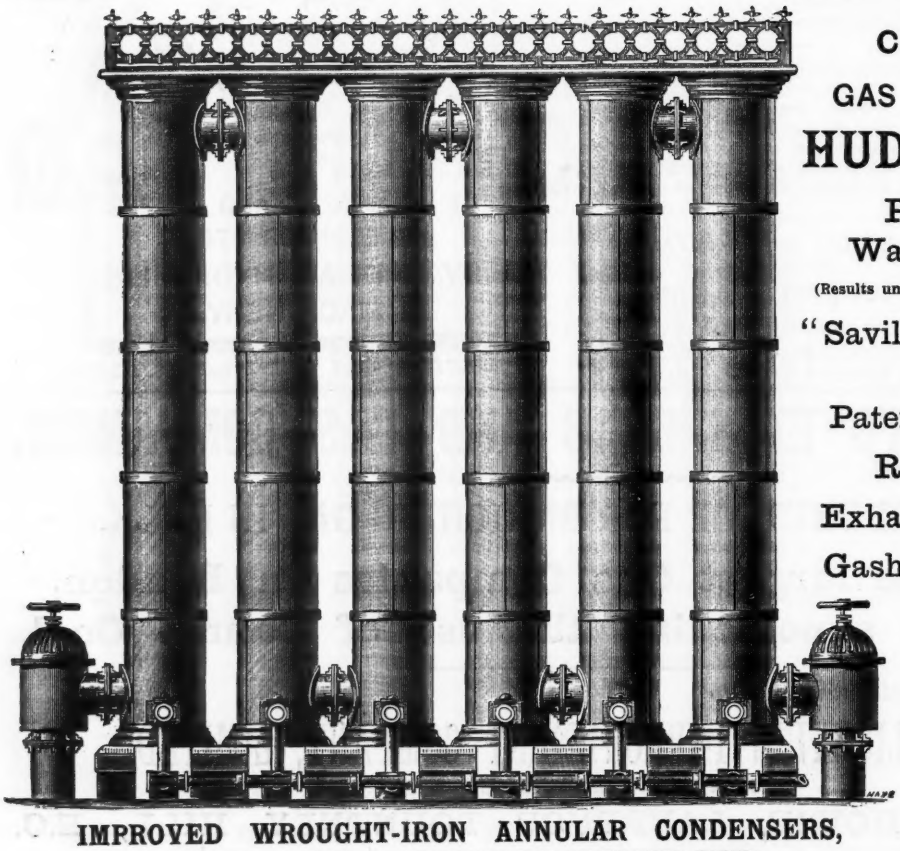

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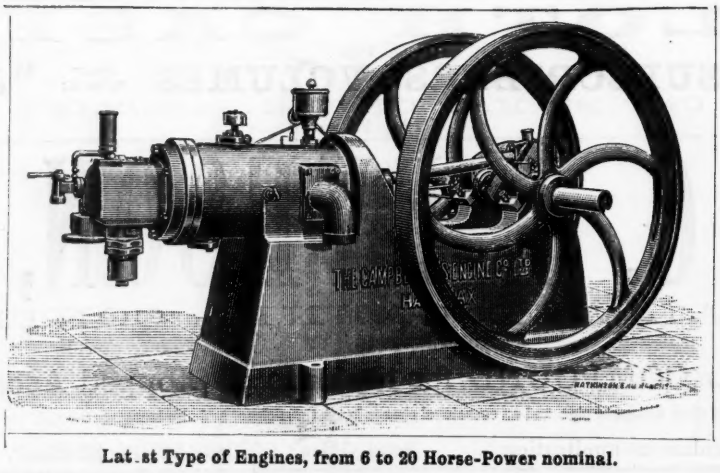

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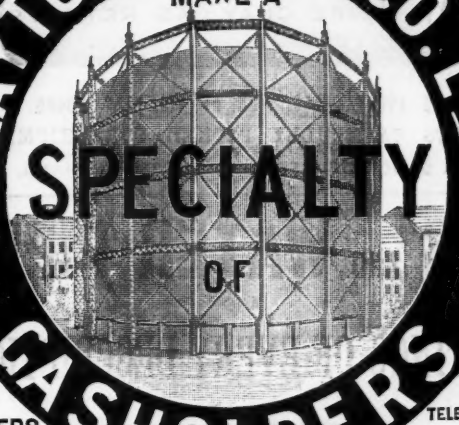

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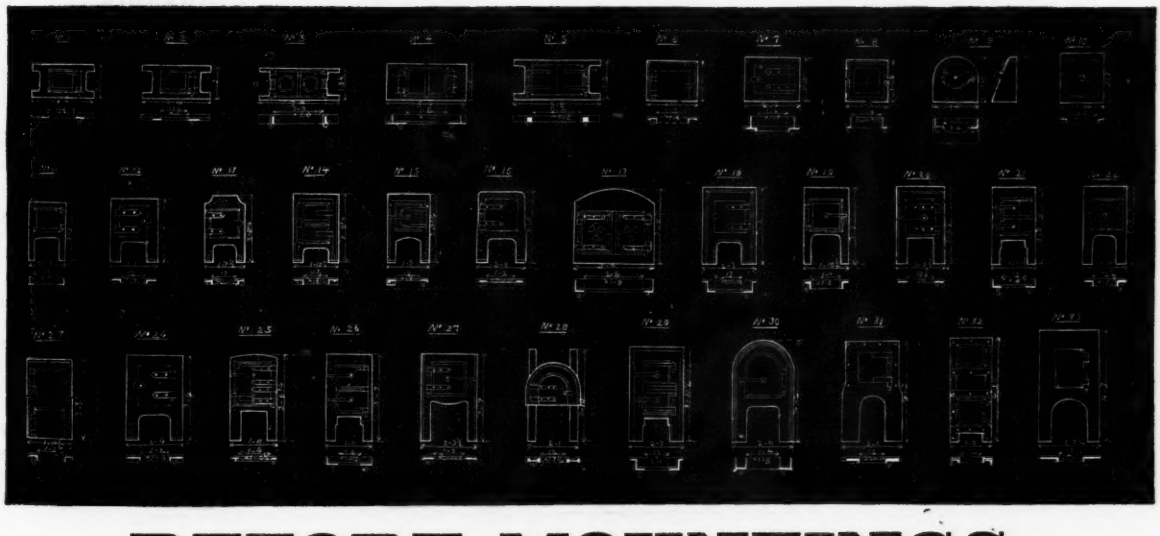

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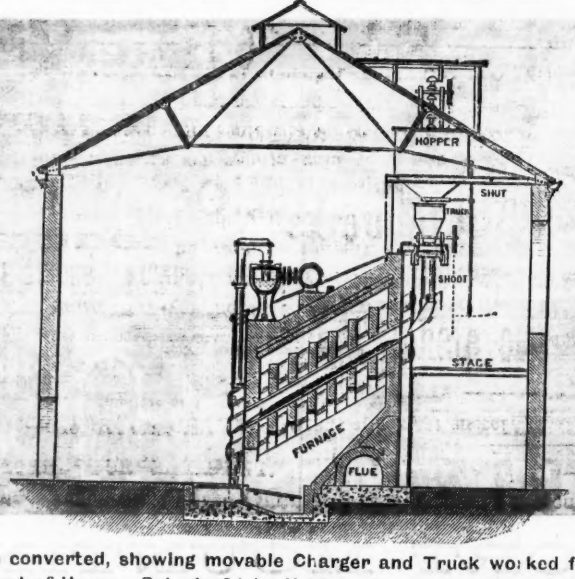

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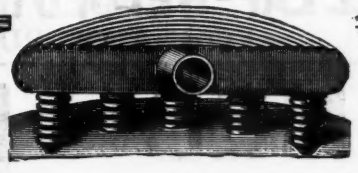

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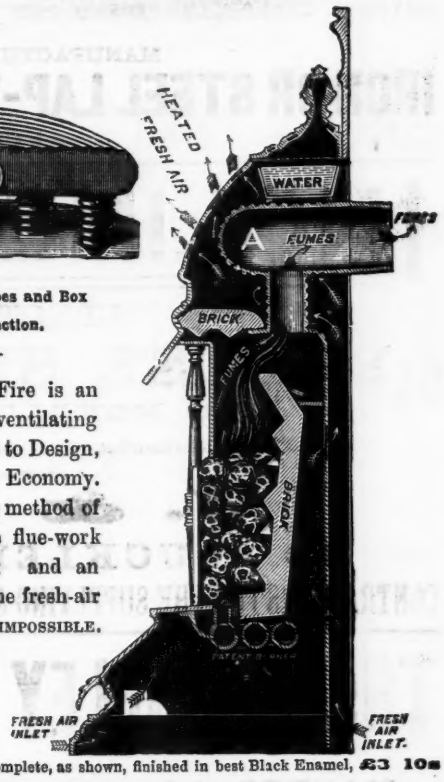

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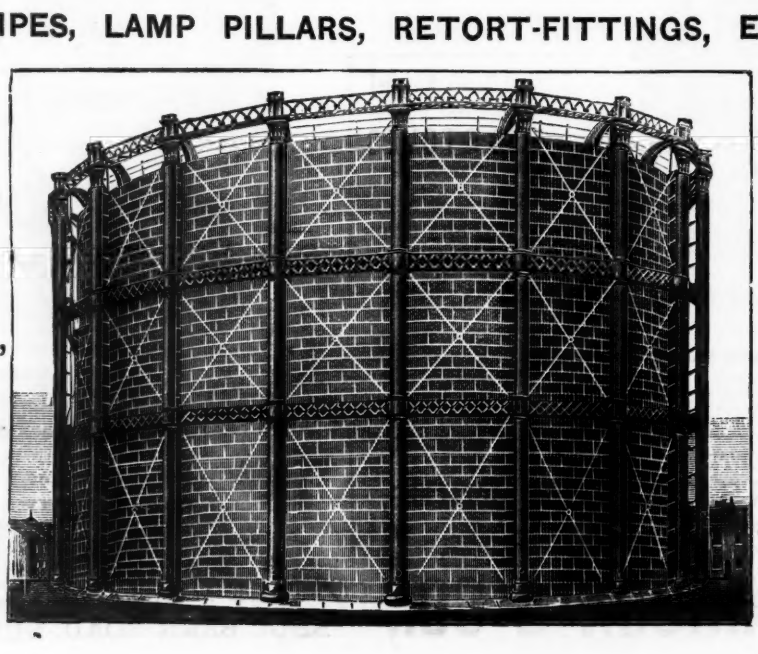

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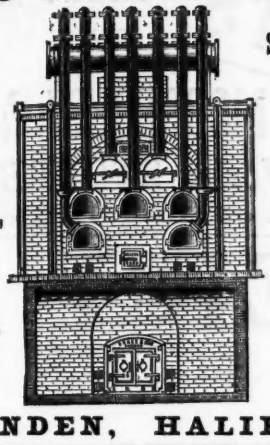

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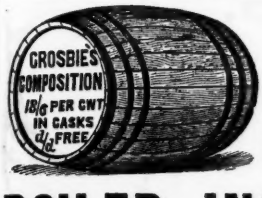

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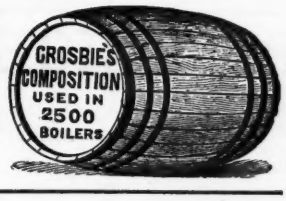

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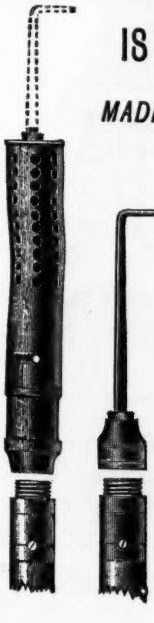

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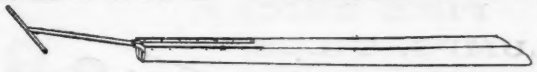

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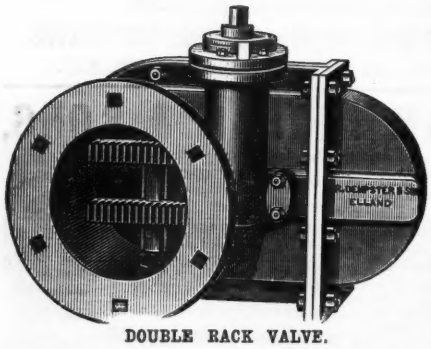

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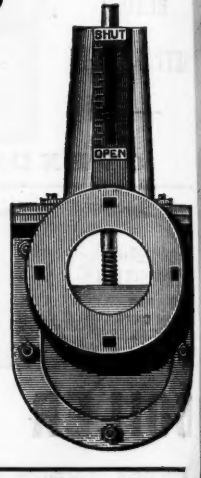

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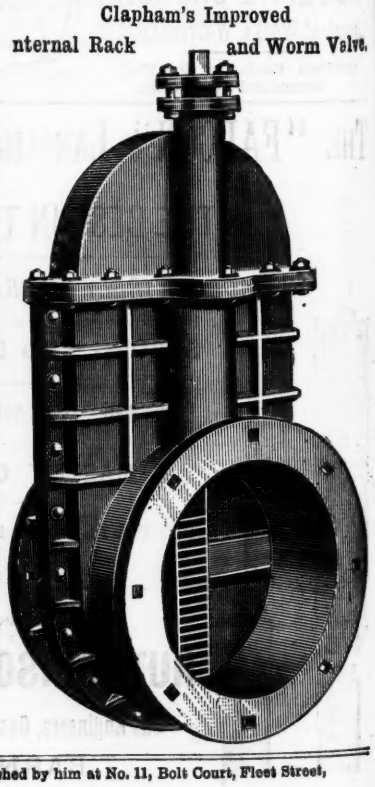

SILVER MEDAL, Inventions Exhibition, 1885.

London: Printed by WALTER KING (at the office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, Jan. 19, 1892.